EMCSF
20.8-3
12/1/04

FMC Idaho LLC

December 2004 RI Update Memorandum

**MARCH 2005 AMENDMENT PAGES
TO BE INCORPORATED INTO THE
DECEMBER 2004 RI UPDATE MEMORANDUM**

INSTRUCTIONS

These are step-by-step instructions for removing outdated pages and inserting the revised pages into the December 2004 RI Update Memorandum. The first column notes which original pages should be removed (DELETE), while the second column (INSERT) refers to the pages included in the replacement/swap page packages. In some cases, new figures were added to the RI Update Memo, and there is no need to remove any original pages. Where the entire text section requires replacement, the DELETE instructions are to "remove all text pages" and the INSERT instructions note "Replace with all new text pages".

The column "REFERENCE COMMENT" indicates the agency comment/topic that the revisions are responding to. These comments and topics are numbered in the "Summary of Comment Status from March 8, 2005 Coordination Meeting (Updated to reflect agreements and actions from the March 17, 2005 conference call)", issued with the replacement pages.

The replacements should be made only with the pages marked "swap pages" in the package with the blue dividers. Do not use the pages with redline/strikethrough revisions as replacement pages to the RI Update Memorandum. These redline/strikethrough pages are included to aid the reviewers in confirming that the agreed revisions have been made.

The revised electronic version of the December 2004 RI Update Memo will be issued in April, 2005.

DELETE	INSERT	REFERENCE COMMENT

Front Matter – List of Acronyms and Abbreviations

Remove pages xiv through xvi	Insert replacement pages xiv through xvii	#1 (no redline/ strikethrough version provided)

Executive Summary

Remove page ES-2	Insert replacement page ES-2	No comment number, typo noted by IDEQ

Section 2

Remove page 2-10	Insert replacement page 2-10	#16
Remove page 2-13	Insert replacement page 2-13	#17
Remove page 2-18	Insert replacement page 2-18	#18 and #20
Remove Figure 2-10 (2 pages)	Insert replacement Figure 2-10 (2 pages)	#13

Section 3

Remove pages 3-8 through 3-11	Insert replacement pages 3-8 through 3-11	#6 and #36

Section 4

Remove page 4-32	Insert replacement pages 4-32 and 4-33	#9

Section 6

Remove all text pages	Replace with all new text pages	#2, #14, #26, #27, #37, and #45
Remove Table 6-1	Insert replacement Table 6-1	#24
Remove Figure 6-14	Insert replacement Figure 6-14	#21
	Insert New Figure 6-5a after Figure 6-5	#14 and #30
Remove Figure 6-10	Insert replacement Figure 6-10	#28
	Insert New Figure 6-10a after Figure 6-10	#47
Remover Figure 6-39	Insert replacement Figure 6-39	

DELETE	INSERT	REFERENCE COMMENT

Appendix D

Remove Appendix D cover page	Insert new cover page	#6 and #36

Appendix E

Remove all text pages	Replace with all new text pages	#6, #12, #32, #33, #34

Appendix H

Remove all text pages.	Replace with all new text pages	#4

SUMMARY OF COMMENT STATUS FROM MARCH 8, 2005 COORDINATION MEETING (UPDATED TO REFLECT AGREEMENTS AND ACTIONS FROM THE MARCH 17, 2005, CONFERENCE CALL)

1. General comment 1. There are new acronyms that have not been included in the acronym list (e.g. PIC – pressurized ion chamber, ICR, AFM (Table 6-3)).

   STATUS: The RI Update Memo will be revised. A revised list of abbreviations and acronyms will be issued as replacement pages to the December 2004 RI Update Memo.

2. General comment 2. It is still not clear whether representative levels are background. If they are, state that, and use consistently in report.

   STATUS: RI Update Memo will be revised. Proposed revisions to the December 2004 RI Update Memo were presented at the March 8, 2005, Coordination Meeting. FMC noted that future documents will use the term "background" instead of "representative".

3. General comment 3. We discussed general comment 3 and 4 as well as specific comment 29, 30, 31 during the February 4th, 2005 conference call. The notes dated February 8, 2005 reflect the discussion. In addition to the issues discussed, please provide additional detail regarding how characterization of the surface using the PIC will be representative of contaminants at depth (since clean fill at the surface may shield the gamma measurement).

   STATUS: Meeting participants agreed that this is a SRI Work Plan Issue. The SRI Work Plan preview conducted during the March 8, 2005 Coordination Meeting provided conceptual approach for addressing this concern.

4. General comment 4. The response to comment 4 references appendix H. Appendix H proposes to composite samples over a 2 foot depth interval. We are not approving Appendix H. When the sampling plan is provided a justification as to how this approach is representative must be provided.

   STATUS: The RI Update Memo will be revised to reflect that Appendix H is provided for information only. FMC and agencies agreed that approval of the RI Update Memo by the EPA does not constitute approval of the sampling approach in Appendix H. Final approval of the sampling approach will occur when the SRI Work Plan is approved.

5. General comment 5. Since arsenic and thallium data results for sample 270-2B are close to the commercial/industrial worker risk based screening concentration, and sample 270-2b was obtained off-site, additional data must be collected on-site in the southern and western portion of the facility to address this data gap for the commercial/industrial scenario. In addition to metals, radionuclides must be analyzed. Figure G2-4 includes radionuclide readings. Areas falling into category g and h exceed 30 uR/hour and need to be remediated. Areas that above background which pose a risk must be included in a remediation unit.

   STATUS: Arsenic and Thallium: EPA indicated this comment was adequately addressed in the presentation materials on March 8. The presentation by Nick Gudka *summarized the available data for thallium and arsenic in surface soils near the undeveloped portions of the FMC Plant OU. FMC will take under advisement the recommendation that composite surface soil samples be taken from the undeveloped areas, particularly the western area, and analyzed for inorganics to confirm that onsite concentrations are lower than screening levels. This issue will be entered on the issues/concerns log.*

Radionuclides: This will be entered on the issues/concerns log, and addressed in the SRI Work Plan. FMC will perform PIC measurements in undeveloped portions of the FMC Plant OU.

6. General comment 6. We do not concur with this response. The conceptual design for the RU 22b sites will be determined in the feasibility study. There is no agreement on design assumptions at this time. This work needs to be part of a feasibility study. For clarification, a discussion regarding data needed for the Microshield model should be included. Since reduction of radon will be a future design requirement it is unclear whether the field gamma measurements will be adequate to assess this. We do not concur, at this point, with the interpretations in the last bullet on page E-9 as we have not reviewed comprehensively, the groundwater monitoring.

   STATUS: The RI Update Memo will be revised. Agencies and FMC were in agreement that the development of design criteria was an issue for the SFS. FMC will add language to the comment response noting the material presented in the comment response is "information only" and intended to illustrate the amount of knowledge relating to the pond history/contents that can be used during the SFS for developing design criteria. A detailed review of this information will be included in the SFS.

   Although not directly related to this comment, the agencies stated concern regarding the data presented in Appendix D. The RI Update Memo will be revised by adding a cover sheet stating that the data are for future use and do not constitute design criteria.

7. General comment 7. There is still a concern regarding the adequacy of the existing groundwater monitoring for purposes of characterizing: 1) organics; organics have been found in the soil column to depths of 100 feet and there is a minimum amount of groundwater data that has been collected for organics; 2) in review of flow maps it appears that there is little or no data from the Bannock aquifer; groundwater flow downgradient of the slag pile could be in the NW direction, and there is no groundwater monitoring immediately down gradient of the landfill sites and the slag pile. The existing groundwater monitoring network should be discussed with respect to the units being evaluated. Groundwater evaluation and possible monitoring is a necessary component of portions of the SRI/SFS for sites which were not evaluated in the EMF RI. In particular, groundwater must be assessed at sites where contaminants have been detected at depth in site soils or where the types of contaminants present tend to migrate rather than adsorbing to surface soils (e.g., P4, organics). The outcome of the groundwater evaluation may require additional monitoring if the wells of interest have not been sampled for the contaminants of potential concern. Additionally, the capping remedy for landfills must meet the substantive requirements of 40 CFR 264.310 (b) (4), which requires long term groundwater monitoring.

   The first step to evaluating groundwater at the landfill sites is to determine groundwater flow directions. The EMF RI section 3.3 shows that there are very few FMC wells that are completed in the Bannock Range Hydrostratigraphic Unit. The wells that exist are limited to a line along the FMC-Simplot fenceline, and may be influenced by effects of the Gypstack Further, the EMF RI illustrates that groundwater flow directions in the Bannock Hills Hydrostratigraphic unit are not well defined (Figures 3.3-8A-F, Figure 3.3-9). These figures show that groundwater conditions in most of the FMC Bannock Hills area have not been evaluated. An evaluation must be done under the SRI to determine if there are wells that are appropriately located and constructed to detect releases to groundwater from buried waste in landfills in this area. If it is determined that there are existing wells that can be used for this purpose, the existing database must be queried to determine if the organic COCs/COPCs have ever been analyzed for in these wells.

STATUS: This issue will be addressed in SRI Report (Nature and Extent/Fate and Transport) and will be entered on the issues/concerns log.

As described during the groundwater/organics presentation during the meeting, FMC plans to sample 6 wells downgradient from the slag pile / landfills for organics (volatile and semivolatile lists) during the 2Q05 groundwater monitoring. The results of that sampling and analysis will be shared with the agencies when available.

8. General comment 8. FMC's response states that soil screening levels will be developed in a subsequent document. The subsequent deliverable and date of submission must be identified.

   STATUS: Meeting participants agreed that this comment had been addressed in the December 2004 RI Update Memo. The text in Section 4 had been appropriately revised. No further changes are needed.

9. The comment requested that a discussion of the uncertainty be included regarding soil screening levels. It does not appear that this has been added to section 4 of the revised document.

   STATUS: The RI Update Memo will be revised. Proposed revisions were reviewed. These revisions will be issued as replacement pages to the December 2004 RI Update Memo.

10. General comment 10. Based on review of the 2002 RCRA ground water monitoring data it does not appear that there is sufficient hydraulic control in order to assess the downgradient direction. It appears that the ground water flow in the vicinity of the slag pile is to the northwest and there are no wells immediately down gradient. The remedy selected in the 1998 ROD is to prevent contamination from migrating off-site above MCLs and to prevent the plumes from expanding. The purpose of the RI update is to assess whether additional source control is necessary to ensure that the 1998 approach to ground water is protective. For sources that have not been evaluated, ground water impacts must be addressed.

    STATUS: This issue will be addressed in SRI Report, specifically, the Geology, Hydrogeology, Nature and Extent, and Fate and Transport sections will have the appropriate information addressing this issue.

11. General comment 11. Gross alpha data should be collected for the slag pile in order to assess potential remedies. In order to assess potential remedies, the slag pile needs to be adequately characterized.

STATUS: During the March 17 Conference call, it was agreed that this issue is an SRI Work Plan topic, and that no revisions to the RI Update Memo are needed. The issue will be noted on the Issue/Concerns Log.

Part 2 Detailed comments:

12. Comment 2. The original RI indicated that precipitator dust was mixed with slag and is present in roads, it appears to be semantics when FMC states that the precipitator dust was not used on construction fill.

STATUS: The RI Update Memo will be revised. FMC's intent was to clarify that precipitator dust was not used as a fill material in the same manner that slag has been used as fill within the FMC Plant OU.

13. Comment 5. Figure 2-10 has not been revised. Although footnote 7 indicates that exposures are precluded through Institutional Controls, the CSM should identify secondary sources that could contribute to contaminant migration. The secondary source and release mechanism would be a concern if contaminants migrated from the pond waters to the pond sediments and then to the soil column beneath the pond. In this scenario, the source of continued contaminant migration need not be the pond sediments, but instead could be continued mobilization of contaminants currently present in the vadose zone. Thus the contaminated soil column is a secondary source through which we attempt to minimize infiltration. The original CSM identified the ponds as the primary source with infiltration/percolation as the primary release mechanism, and soil/sediment as a secondary source with infiltration/percolation as the secondary release mechanism.

STATUS: The RI Update will be revised. Revisions were reviewed during the March 8 Coordination Meeting. A replacement figure will be issued.

14. Comment 8 – The response states the Table and document have been revised. Neither Table 2-4 nor Section 6 has been revised as stated in the response.

STATUS: This comment was not discussed during the March 8 Coordination Meeting. During the March 17 Conference call, it was agreed that Table 2-4 did not require any further revisions. Section 6, and the comment response in Appendix E will be revised to reflect that the storm drains are located in RU 3 (Receiving and Stores), not in RU 4 (Office and Admin Buildings). Figure 6-10a will include the location of the storm drain outfalls at RU 22c (Railroad Swale).

15. Comment 9 – The feasibility study must be completed for all areas with the exception of those requiring no further action.

STATUS: No revisions are needed to the RI Update Memo. During the March 15 Conference call it was agreed that the RI Update Memo had indicated that all areas will be addressed in the SFS, except areas that require no further action.

16. Comment 14 – This comment was not addressed in the revisions submitted to EPA on September 7, 2004. This section of the Update Memorandum must be updated to express the uncertainty regarding potential impact to groundwater from sites operated without a sustained hydraulic head.

STATUS: The RI Update will be revised. Revisions were reviewed during the March 8 Coordination Meeting, and replacement pages will be issued.

17. Comment 16 – The text in the December 2004 submittal has not been revised as indicated.

STATUS: The RI Update will be revised. Revisions were reviewed during the March 8 Coordination Meeting, and replacement pages will be issued.

18. Comment 17 – Since it is possible to sell water rights, use of FMC's groundwater for irrigation off plant is a potential use. The accumulation of metals in soil based on use for irrigation should be assessed.

STATUS: The RI Update will be revised. Text will be inserted into Section 2 to note that the SFS will evaluate groundwater uses other than drinking water. Future potential uses will include cooling water, process water (generic), and irrigation (likely restricted to the western undeveloped portion of the FMC Plant OU). This will be entered onto the Issues/Concerns Log.

19. Comment 23 – The last paragraph of this response is not consistent with the approach EPA has viewed for the RI update. An assessment of sources not evaluated in the original RI is required as part of the RI update. An evaluation as to whether the source has contributed or has the potential to impact the aquifer and if action is necessary to prevent further degradation of the aquifer is an effort that is expected for the RI update.

STATUS: Meeting participants agreed that this is a SRI Work Plan/SRI Report issue. This issue will be noted on the new issues/concerns log in order to be fully addressed as part of the SRI Work Plan/SRI Report.

20. Comment 24, the response is unacceptable. The risk assessment must assume that no land use or administrative restrictions are in place for the future use scenarios.

STATUS: The RI Update Memo will be revised. During the March 17 Conference call, it was agreed that Section 2 (page 2-18) should be revised to clearly state that the CSM assumes that current administrative controls will not apply to future site workers.

21. Comment 27, the response defines shallow soil as 0-10 feet which is inconsistent with the document which state 0-6 feet.

STATUS: The RI Update Memo will be revised. FMC participants could not find any remaining inconsistencies. Subsequent to the March 8 Coordination Meeting, EPA identified an error on Figure 6-14 of the RI Update Memo. FMC will review the remaining summary figures for each RU to ensure they are consistent with the document text.

Replacement pages will be issued, as needed.

22. Comment 30, page E-31 states that a surrogate for radionuclide specific activity data for areas of the plant that do not contain "significant quantities of phossy solids". Significant quantities must be defined.

    STATUS: SRI Work Plan issue. Definition of significant quantities will be a function of XRF precision and accuracy and bench scale testing.

23. Comment 45, see concerns with general comment 5.

    STATUS: EPA indicated that this comment was adequately addressed in the March 8 presentation materials provided in response to general comment 5.

24. Comment 59, since VOCs were detected in soils beneath the lab pit they should be listed as COCs not COPCs.

    STATUS: The RI Update will be revised. Revisions were reviewed during the March 8 Coordination Meeting, and replacement pages will be issued.

25. Comment 62 – We do not concur with the response to general comment 6.

    STATUS: As discussed during the March 8 Coordination Meeting, this will be addressed as part of the SFS.

26. Comment 65 – The boring was not located in RU 15 or RU 16. Sample 12 7B is 800 feet north of F01B and contaminants were found at the depth of the boring. The response is not supported by the characterization data and does not address the concern. The data from samples collected in boring F051B located in RU 16 indicates that metals concentrations that are elevated above "representative" levels were detected to depths as deep as sampled (14 feet) [EMF RI, Table 4.2.3-33]. The comment response appears to be referencing data from a deeper boring (F127B) located in a different RU. Boring F127B is located at least 800 feet north of boring F051B in RU 15. Although the boring log for F-127B identified some grayish-brown sludge present between 0-5 foot depths, the primary wastes identified in RU 15 are oversized ore, broken electrodes and baghouse dusts. There is insufficient evidence, on the basis of a single boring, to infer that contaminant distributions in RU15 are representative of those in RU 16, especially since these sites apparently managed different wastes. Data from boring F127B should not be used to form interpretations regarding the vertical extent of contaminant migration in RU16.

    STATUS: The RI Update Memo will be revised. Margie English, Matt Janowiak, and Jim Sieverson will collaborate to develop revised descriptions for RU 15 and RU 16 to more fully describe past land use and discuss the available data for these RUs.

27. Comment 67 – The response did not address the two sentences of the comment.

    STATUS: The RI Update Memo will be revised. Margie English, Matt Janowiak, and Jim Sieverson will collaborate to develop revised descriptions for RU 15 and RU 16 to more fully describe past land use and discuss the available data for these RUs.

28. Comment 68 – A note needs to be provided on the figure that no sample results were collected from boring F160B.

STATUS: The RI Update Memo will be revised. The note will be added to the figure and a revised figure will be issued as a replacement page.

29. Comment 69 – Although we agree with the general vision of a cap for RU 8, the specifics of the type of cap and site preparation, including whether or not concrete slabs are left in place, must be left to the feasibility study.

STATUS: SFS issue. The remediation vision for RU 8 will be reviewed and revised, if necessary, during the SFS phase.

30. Comment 70 – The extent of the liner and storm drain location is not depicted on Figure 6-5 as stated in the response. The second paragraph of the comment is not responded to.

STATUS: The RI Update Memo will be revised. The liner and storm drain location will be shown on the figure and a replacement page will be issued. The second paragraph deals with SRI Work Plan and SFS issues and will be entered on the issues/concerns log.

31. Comment 73 - It is not clear when the modeling will be conducted and when the decision to sample for metals will be made. If metal data needed for characterization of this area it should be proposed in the sampling plan.

STATUS: FMC clarified that the thermal modeling effort is underway and the preliminary results will be provided for agency review prior to the SRI Work Plan. Collection of metals/inorganics around RU 1 and RU 2 is an SRI Work Plan issue and will be entered on the issues/concerns log.

32. Comment 74 – Whether pipes are left in place, decontaminated, or removed should be part of the feasibility study. Likewise, whether or not sumps or other process equipment are decontaminated, backfilled, grouted, or removed is a question to be decided in the feasibility study. Worker risk and compliance with ARARs are part of the detailed analysis of remedial alternatives that will be conducted as part of the focused FS. The focused FS will examine various remedial alternatives for the ancillary process equipment and cover. We do not concur with the response because these details are not appropriate in the RI Update Memorandum.

STATUS: The RI Update Memo will be revised. The information provided in the RI Update Memo describing site conditions will clarify that these are site conditions after D&D work is completed. In effect, these conditions will represent the starting point for evaluating remedial alternatives in the SFS.

33. Comment 76 – same as comment # 74 above.

STATUS: The RI Update Memo will be revised. See #32 above.

34. Comment 77 – same as concern with response to comment 74.

STATUS: The RI Update Memo will be revised. See #32 above.

35. Comment 78 – Organics were found at depth. For some samples, the deepest sample had the highest level of contamination. This data cannot be ignored.

STATUS: SRI Work Plan/SRI Report issue. This will be entered on the issues/concerns log. During the March 17 Conference call, FMC clarified that there was insufficient organic data to perform statistical comparisons between site conditions and SSLs.

36. Comment 81 – This information should be part of a remedial design document for the cover. This appendix is not necessary and it is not being reviewed or concurred on.

STATUS: The RI Update Memo will be revised. Specifically, the response to the original comment #81 in Appendix E will note that Appendix D was provided for information and to complete the task of the RI Update Memo (i.e., providing agencies data relevant to the SRI/SFS and RD/RA process collected since the EMF RI).

37. Comment 82 – The second sentence of FMC's response contradicts the text referenced in the original comment. The referenced text is now found on Page 6-19, paragraph 2 of Technical Area 1 Waste Area Delineation, last sentence; *"Material that has no value as scrap will be landfilled in the area between RU 17 and RU 18".*

Additionally, the fourth sentence of FMC's response contradicts the following statement found under Technical Area 4—Existing Cover Assessment, Page 6-22, paragraph 2: *"Because **RU 17** [emphasis added] and RU 18 are likely to be expanded to dispose of unsalvageable building material during plant decommissioning . . ."*

Review text in the RI update and revise to address these comments.

STATUS: The RI Update will be revised. Proposed revisions were reviewed during the March 8 Coordination Meeting. Replacement pages will be issued.

38. Comment 84 – We are not concurring with the type of testing proposed. We agree that characterization in this area is required. However, the nature of the investigation should be developed and agreed on through the DQO process, and presented in the workplan.

Additionally, the potential source and release mechanism described in the response is outside of the revised conceptual site model. As described, precipitation/infiltration through a surface source that did not contain free liquids or have a sustained hydraulic head, may have contaminated groundwater. If this is confirmed, the conceptual site model must be revised.

STATUS: SRI Work Plan issue. This will be entered on the issues/concerns log and addressed in the SRI Work Plan.

39. Comment 85 – The response did not address testing for SVOCs.

STATUS: The RI Update will be revised. Replacement pages will be issued.

40. Comment 86 – All data must be included in the RI update as background information and the potential for the source to impact the aquifer. Only a limited number of sources and the impact to the aquifer were assessed in the original RI. The RI update needs to assess the potential for the sources, not assessed in the original RI, to impact the aquifer.

STATUS: SRI Work Plan and SRI Report issue. This will be entered on the issues/concerns log and addressed in the SRI Work Plan/SRI Report.

41. Comment 88-93

Chebyshev's inequality method does not work well for small sided data sets. It works well only for data with small to moderate skewness and variance. Chebyshev's 95% UCL will not cover the true mean when there are only 4-9 points available and have high variation. The calculated 95% UCL is usually biased low. We suggest either using methods recommended by EPA for small sample sizes such as bootstrapping. If Chebyshev's is used, 99% UCL is recommended to improve the coverage of the true mean, (EPA 2002).

Status: Although the Chebyshev inequality method is not always the EPA-recommended method for determining the 95% UCL of the mean concentrations, FMC selected this method because it consistently provided the highest estimate of the 95% UCL of the mean concentrations. This approach added a degree of conservatism when comparing small sample sets to the RBCs, and it also reduced the delta term when calculating the number of samples required to support a decision regarding whether or not site concentrations exceeded the RBCs.

When a high proportion (>15%) of a small samples (i.e. n=4-9) are nondetects, Cohen's adjustment is inappropriate as distribution assumptions can not be adequately assessed. EPA 2002 recommends bootstrap/jackknife resampling to calculate the 95% UCL. To make the resampling simulations valid, the collected samples should be representative.

Status: As noted above, the Chebyshev method consistently provided the highest estimate of the 95% UCL of the mean concentrations. In almost all cases, bootstrap and jackknife methods were lower than the Chebyshev method value. No revisions to the RI Update Memo were made in response to this comment.

Please provide information on power analysis method used to check sample size sufficiency.

ProUCL does not handle left-censored data and can't be used to calculate the 95% UCL of such data.

Status: No revisions to the RI Update are needed. This was discussed during the March 17 Conference call, and the text in Section 6 included a discussion of the power relating to sample size calculations.

(NOTE: Further discussion of the statistical methods occurred during the March 17 Conference call. A followup conference call on April 1, 2005 brought resolution to this

issue with regard to revising the RI Update Memo. Specifically, there was discussion regarding the calculation of the "gray area" or "delta" values used to calculate the number of samples required to support the decision. FMC will issue a technical memo providing a comparison between different methods for calculating the delta term. In addition the technical memo will provide a comparison of the 95% UCL values calculated from the Chebyshev method, the bootstrap method, and the jackknife method to illustrate that the Chebyshev method is typically the highest estimate of the 95% UCL of the mean.

42. Comment 95 – This text has not been added to the document.

    STATUS: Text was added in December 2004 RI Update Memo. Reviewed text during the March 8 Coordination Meeting. No further revisions needed.

43. Comment 98 – Since the ditch is part of the scrubber ponds it is unclear why it is in two different RUs.

    STATUS: Explained during the March 8 Coordination Meeting. RU 8 boundaries are defined by the calciner facilities, and the former kiln scrubber overflow ditch lies partially within RU 8 and the adjacent RU 9. The ditch and the former kiln scrubber overflow pond are likely to contain much lower quantities of kiln scrubber solids because they transported/stored clarified water. The investigation at RU 9 will characterize the conditions at the ditch and pond.

44. Comment 99 – Where TPH was found samples should be analyzed for VOCs and SVOCs.

    STATUS: SRI Work Plan issue. This will be entered on the issues/concerns log and addressed in the SRI Work Plan.

45. Comment 103 – The RU description in Figure 6-39 doesn't reflect the response as indicated. The response states that calciner pond sediments were found in boring F127B. The site description must be modified to reflect this. This information complicates the remediation vision for RU 15. On the basis of this single boring, it is unclear whether this RU has been sufficiently characterized. If there are substantial amounts of calciner pond sediments present in RU 15, vertical contaminant migration may be a concern, as it is at RU 16. Until it is determined if RU 15 contains significant amounts of calciner pond sediments, it is not possible to concur with the remediation vision of a soil cap for the same reason that there is uncertainty regarding the type of cap at RU 16. Additionally, it remains unclear whether the single boring was located in an area that was proximal to the all three types of wastes originally identified at this site (i.e., mounds of reject ore, baghouse dusts, and broken electrodes). This information cannot be determined from Figure 6-40, because there is no information how the various wastes are distributed within the site. The nature and extent of contaminants seems to still be a data gap.

    STATUS: The RI Update Memo will be revised. Margie English, Matt Janowiak, and Jim Sieverson will collaborate to develop revised descriptions for RU 15 and RU 16. The revisions will be issued as replacement pages.

46. Comment 109 – Road areas need to be characterized for inorganics. EPA has indicated

to the Tribes that roads will be sampled as part of the RI, at minimum, in areas where treated pond water was used for dust suppression. In addition, areas where precipitator dust was used metals may exceed risk based concentrations.

STATUS: SRI Work Plan issue. This will be entered on the issues/concerns log, and addressed in the SRI Work Plan. FMC noted that it is their intent to perform inorganic analyses on fill materials from road segments in RU 23.

47. Comment 118 -- It does not appear that this information was added to Section 6.

STATUS: The RI Update Memo will be revised. Replacement pages will be issued.

Reference Cited

OSWER 9285.6-10, "Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites"

EXECUTIVE SUMMARY
REVISIONS
REDLINE/STRIKETHROUGH

substantive changes in site conditions at the Old Phossy Ponds (RU 22b), ~~the Calciner Solids Stockpile Area (RU 22c)~~ and the Railroad Swale (RU 22c) since the EMF Site RI/FS was completed. The conclusion of the 1998 EMF Site ROD that remedial action is needed at these areas therefore continues to be supported.

Additional site characterization data are needed at the remaining RUs. However, these data needs are spatially focused and include:

- Delineating the lateral extent of a RCRA-engineered cap to prevent exposure to soils containing elemental phosphorus associated with historic spills and leaks from process equipment at the former elemental phosphorus production, storage, and handling areas in RU 1 and RU 2;
- Measuring gamma radiation levels where slag has been used as construction fill;
- Sampling several sites in RUs 4, 5, and 20 where fuel oils and solvents were managed to determine the need for potential "hotspot" removal; and
- Collecting additional soil samples at RUs 3, 4, 5, 6, 9, 11, and 13 to compare inorganic constituents with screening criteria at a greater statistical confidence level than can be supported with the existing data.

No further site characterization data are needed to evaluate potential risks to ecological receptors in the undeveloped western and southern portions of the FMC Plant OU. While there are minor excedences of target risk thresholds for several avian and plant species with respect to fluoride, there is only a marginal likelihood that an adverse effect on population size or community composition of species in the area will occur.

A supplemental remedial investigation to address the data needs identified in this Memorandum will be implemented and can be completed in a timeframe that supports future commercial/industrial redevelopment of the site.

SECTION 2
REVISIONS
REDLINE/STRIKETHROUGH

- Infiltration/percolation of constituents from a) unlined waste management units that operated with a sustained hydraulic head; b) unlined waste management units at which wastes containing free liquids were managed; and c) petroleum storage facilities, could have impacted subsurface soils
- Deposition (fallout) of constituents from former emissions at the FMC and Simplot facilities;
- Process spills and leakage from former P4 production, storage, and handling areas;
- Storage of feedstocks, byproducts, or waste materials in unlined stockpiles;
- Use of feedstocks, byproducts, or waste materials as fill (including use of materials in roadbed); and
- Spills of solvent and/or petroleum hydrocarbons at limited areas of RU 5, 12, 20, and 22b.[5]

Air: Air quality may be impacted through the following release mechanisms:

- Generation of fugitive dusts by wind;
- Generation of fugitive dusts by vehicle traffic on unpaved roads containing feedstocks, byproducts, or waste materials;
- Generation of fugitive dusts from excavation of impacted soils;
- Oxidation of P4 during excavation soils containing over 1,000 mg/kg P4, resulting in a potential fire or evolution of smoke (P2O5);
- Radon emanation from feedstocks, byproducts, or waste materials containing radium-226;[6]
- Intrusion of organic vapors into buildings overlying the limited areas of RU 5, 12, 20 and 22b at which solvent wastes may be present[7]; and
- Air emissions from the adjacent J.R. Simplot Co. facility.

Groundwater: Groundwater quality may have been impacted through the following release mechanisms:

- Infiltration/percolation of constituents from unlined waste management units that operated with a sustained hydraulic head, and in the case of the J.R. Simplot Co. gypstack, continues to operate with a sustained hydraulic head. In addition, groundwater quality may have been impacted through the operation of unlined waste management units at which wastes containing free liquids were managed, and potential impacts may have occurred from petroleum storage facilities (SC #14)

[5] The potential presence of solvent and petroleum hydrocarbon contamination is believed to be restricted to RU 5, 12, 20, and 22b as discussed in Section 6.

[6] The EMF ROD requires that future office buildings be constructed using radon control methods specified in an EPA guidance document titled "Radon Prevention in the Design and Construction of Schools and Other Large Buildings" (EPA 1994a)

[7] The potential presence of solvent and petroleum hydrocarbon contamination is restricted to RU 5, 12, 20, and 22b as discussed in Section 6.

for the FMC Plant OU will be used as a framework to develop the scope of a supplemental remedial investigation and feasibility study of remedial action alternatives for the FMC Plant OU.

EPA provided two sets of comments from the agency coordination committee on an October 2003 draft schematic of the updated CSM. These comments, which are reprinted in Table 2-4, concern the identification of potential sources, release mechanisms, exposure media, and exposure pathways. Table 2-4 outlines how these have been addressed in the updated CSM.

The updated CSM illustrates how contaminants from source areas may be transported to other media and identifies which media are of principal concern with respect to potential current and future receptors and exposure pathways. The updated CSM reflects a future commercial/industrial land use for the FMC Plant OU, with institutional land use controls in place that prevent residential uses of the site as well as preventing consumption of contaminated groundwater, as required by the EMF ROD for the FMC OU.

Figure 2-10 illustrates the updated CSM for potential human exposure within the FMC OU. Individuals potentially exposed to FMC OU-related contaminants include current and potential future site workers and nearby residents. The principal current and/or potential future exposure pathways are:

- Dermal contact with, and incidental ingestion of, contaminated soils, byproducts, and waste materials;
- External radiation exposure from contaminated soils, byproducts, and waste materials;
- Inhalation of fugitive dusts generated during excavation of contaminated soils, byproducts, and waste materials;
- Fire or smoke if P4 is exposed to air as a result of excavation of subsoils containing P4 at a concentration above 1,000 mg/kg;
- Incidental ingestion of P4 and inhalation of fugitive dusts assumed to contain phosphoric acid are potential exposure pathways for soils containing less than 1,000 mg/kg P4;
- Inhalation of radon, and exposure to radon-decay products, in indoor air;[12]
- Inhalation of organic vapors intruding into indoor air by indoor workers at limited portions[13] of RU 20; and
- Inhalation by off-site residents of fugitive dusts generated by wind and traffic on unpaved roads during site construction activities.

[12] The EMF ROD requires that require that future office buildings be constructed using radon control methods specified in an EPA guidance document titled "Radon Prevention in the Design and Construction of Schools and Other Large Buildings" (FMC 1994a)

[13] The potential presence of solvent and petroleum hydrocarbon contamination is believed to be restricted to RU 5, 12, 20, and 22b as discussed in Section 6.~~The potential presence of solvent and petroleum hydrocarbon contamination is restricted to RU 20, as discussed in Section 3~~ (SC# 16).

current workers are similarly applicable to future workers associated with potential industrial reuse of all, or portions of, the FMC facility. The CSM also assumes that there will be no administrative controls in place that will reduce or control future site worker exposures.

The updated CSM identifies four types of future receptors: Commercial/Industrial Worker (subdivided into an Indoor Worker and an Outdoor Worker[17]); Utility Installation Worker; Construction Worker; and Off-site Resident.[18]

There is no current residential use of land within the FMC Plant OU and residential use of land within the FMC Plant OU would be inconsistent with industrial reuse. Moreover, FMC has filed land use restrictions with Power County that preclude residential uses of the FMC Plant OU, with the exception of the parcel formerly owned by the Union Pacific Railroad containing the closed Batiste Spring pumphouse. The FMC plant obtains its drinking water from wells within the deep aquifer, which currently meets MCLs. Future potential users of the FMC Plant OU would be required to obtain drinking water from wells within the deep aquifer or from the Pocatello municipal water supply system. Other potential uses of the groundwater beneath the FMC Plant OU, such as cooling water, process water, or possibly irrigation (likely restricted to the western undeveloped portion of the FMC Plant OU) will be evaluated in the SFS. Available data will be reviewed as part of the SRI to ensure the data will support this evaluation.

[17] A commercial/industrial worker may divide his/her time between indoor and outdoor activities.
[18] The Off-Site Resident might inhale fugitive dusts generated by traffic on unpaved roads during site construction activities and wind generated fugitive dusts for the remainder of the exposure duration.

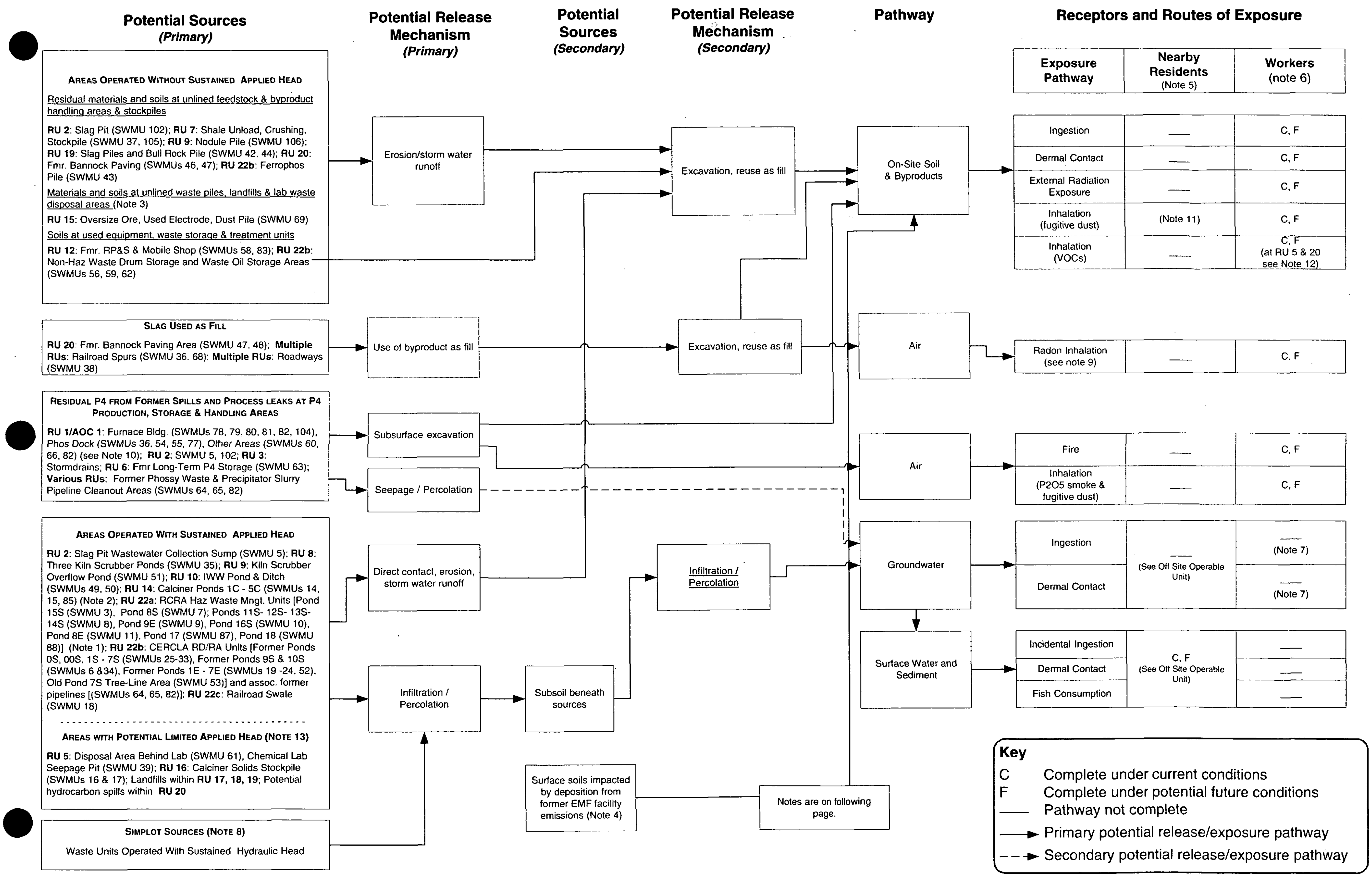

Figure 2-10: Conceptual Site Model for Potential Human Exposure to Contaminants at the FMC Operable Unit

December 2004

Note 1 - These waste management units are in the process of closure pursuant to RCRA standards.

Note 2 - Remediation of the Calciner Ponds 1C-5C and the underlying Old Calciner Ponds is being conducted under a Consent Order with the IDEQ.

Note 3 - Railcars within Slag Pile included in RU 19. Alledged buried transformers included within RU 12.

Note 4 - Includes potential deposition resulting from former emissions from the FMC and Simplot facilities.

Note 5 - Based on the ROD definition of off-site areas (i.e., properties not owned by FMC or Simplot).

Note 6 - Administrative controls protect current workers from exposure.

Note 7 - Exposure precluded through administrative controls and land use restrictions.

Note 8 - Potential sources at the Simplot facility are subject to the Simplot CERCLA RD/RA Consent Decree and applicable Clean Air Act standards. Evaluation of these sources, including development of remedial action objectives, is not within the scope of the supplemental RI/FS for the FMC OU.

Note 9 - Future office buildings are to be constructed using radon control methods, per EMF ROD.

Note 10 - RU1 SWMUs 13, 73, 74, and 76 did not manage P4-containing materials. These SWMUs have been "clean closed" and are not included.

Note 11 - Off-Site Resident might inhale fugitive dusts generated by vehicle traffic on unpaved roads during site construction activities.

Note 12 - The presence of "hotspots" of volatile organic compounds at limited portions of RU 4 (SWMU 61: Disposal Area Behind Laboratory), RU 5 (SWMU 39: Chem Lab Seepage Pit) and RU 20 (Former Bannock Paving Area) are subject to further evaluation.

Note 13 - These areas did not operate with a sustained hydraulic head in a manner similar to a pond. However, free liquids may have been present in the waste materials managed or disposed at the area. If present, these free liquids may have seeped into underlying soils and groundwater.

SECTION 3
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Geotechnical Data for Cap Design

Geotechnical data were obtained for soils and slag used in the construction of caps at RCRA WMUs in RU 22a. These materials are anticipated to be used in constructing caps at other RUs, and these data will be useful in designing the caps. These data are provided for information only and are not considered final design criteria. FMC understands that any design approvals required by the EPA will occur after preparation and review of the appropriate design documents during the SFS and RD/RA phase.

Bannock Paving Area Spill Investigation

In 1997, the Jack B. Parsons Company, operators of the former Bannock Paving Company Area (RU 20), conducted a site investigation to determine the nature and extent of contamination associated with a reported spill of approximately 1,000 gallons of oily sludge from a railcar. A former employee reported the spill occurred as BAPCO employees were preparing a railcar for use as a storage tank, and they dumped the oil sludge from the bottom of the railcar to the ground. As part of this investigation, eight test pits were dug in the spill area, and samples of native soils were collected from the base of these test pits. In one test pit, TP-6, there was visual evidence of petroleum hydrocarbons within the slag fill. A sample was collected from the depth interval of 2 to 3 feet below the surface, and one sample was collected from the native soils at a depth of 5.5 feet. Results are summarized in Table 3-4, and the sample locations are shown in Figure 3-1.

Coke Analyses

TCLP test data were obtained from analysis of samples of coke supplied by the FMC facility in Kemmerer, Wyoming.

FTIR Data at Ponds 16S, 17, and 18

Open-path Fourier Transform Infra-Red (FTIR) Spectrometers were installed at Ponds 16S (WMU #10; SWMU 10), Pond 17 (WMU #14; SWMU 87), and Pond 18 (WMU #15; SWMU 88) in 1999 to continuously monitor phosphine and hydrogen cyanide concentrations at the berms of each pond. The FTIR systems were installed pursuant to the RCRA Consent Decree. Quarterly summaries of the FTIR data were submitted to EPA Region 10 and the Shoshone-Bannock Tribes. The FTIR systems at Ponds 16S and 17 were removed during installation of the initial fill and temporary covers at each pond. The initial fill and temporary cover was installed at Cell A of Pond 18 in 2002. Cell B of Pond 18 will be closed by waste removal at a later date. The Pond 18 FTIR system, which encompassed Cell A and Cell B of Pond 18, was removed in January 2004 after EPA agreed that the system was no longer necessary.

While these FTIR data may be useful in characterizing phosphine and hydrogen cyanide emissions from operating ponds, they do not appear to be relevant to the current status of the ponds and have not been included in the FEDS database.

EPA Radionuclide Study of P4 Thermal Process and Other Studies

EPA collected 6 samples of phosphate ore, 6 samples of calcined briquettes, one sample of silica, one sample of coke, one sample of ferrophos, and 6 samples of slag in December 1976 from the FMC facility. These samples were split. One set was analyzed at EPA's EMSL laboratory and the other set was analyzed at EPA's EERF laboratory. Both laboratories analyzed these samples

SECTION 4
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4.6.3 Summary of Off-Site Residential SSLs

Table 4-19 presents the COPC-specific, off-site residential fugitive dust inhalation SSLs for carcinogenic and non-carcinogenic endpoints. In the case of COPCs that exhibit both carcinogenic and non-carcinogenic effects, the health endpoint resulting in the lowest SSL was conservatively used to characterize the screening level for that constituent.

For P4, the toxicity-based SSL was found to be greater than the level at which this constituent may spontaneously oxidize (smoke). However, there is no potential for off-site residents to be directly exposed to P4-containing soils on the FMC Plant OU. Consequently, the concentration at which spontaneous oxidation may occur (1,000 mg/kg) is not relevant to this receptor.

By comparing the off-site residential SSLs (Table 4-18) to those developed for a construction worker (Table 4-16), it is evident that the construction worker SSLs are consistently more conservative (i.e., lower) than the off-site residential SSLs. Therefore, use of the construction worker SSLs for screening RUs in which redevelopment could potentially occur within the SRI/FS will be protective of off-site residential receptors.

4.7 Summary

Table 4-20 summarizes the chemical-specific SSLs calculated in this section for outdoor and indoor commercial/industrial workers, construction workers, utility workers and off-site residents. These SSLs were ~~largely~~ derived using the default methods ~~based on conservative default assumptions~~ contained within current EPA guidance (EPA, 2002). Additionally, in the absence of site-specific data, EPA's default values were used to characterize each of the parameters within the SSL equations. EPA (2002) states that "These equations and the default input values are designed to reflect reasonable maximum exposure (RME) for chronic exposures in a commercial or industrial setting". Moreover, EPA (2002) indicates that while the default values were not selected to represent worst case conditions, they are conservative. Thus, uncertainty within SSLs derived using EPA's default methods and assumptions errs on the side of worker protection. When available, and in accordance with the guidance, site-specific data were used to characterize input parameters (e.g., meteorological factors). The use of site-specific data, in place of the default input values, inherently lowers the degree of uncertainty within the derived SSLs. Finally, in the absence of both site-specific data and default values, professional judgement, supported by EPA SSL case study assumptions, was used to characterize several input parameters describing the specific details of a future site redevelopment scenario at the FMC Plant OU. While these latter input values are likely associated with the greatest degree of uncertainty, it should be noted that EPA does not identify any of the parameters characterized using professional judgement as being sensitive with respect to the model results. Moreover, the selected values are considered conservative with respect to characterizing any future redevelopment of the FMC Plant OU. Thus, each of the SSLs derived in this section are considered to be conservative (i.e., err on side of worker protection), and can be applied as risk-based screening levels in the evaluation of the need for additional sampling and/or remedial action within select FMC Plant OU RUs throughout the SRI/FS process.

As shown by comparing the chemical-specific SSLs for each receptor, the construction worker SSLs are consistently lower (i.e., more conservative) than the screening levels for each of the other receptors. Thus, for RUs on the FMC Plant OU in which construction redevelopment could potentially occur, use of the construction worker SSLs to screen COPCs within the SRI/FS

SECTION 6
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Section 6
Application of DQO Process to Remediation Units

This section presents a comparison of the expanded set of available site characterization data with the RBCs presented in Section 4 (along with the RBC developed for P4) as a screen to identify areas potentially requiring additional characterization.

This section also includes a comparison of site characterization data with representative levels of constituents in soils. The term "representative levels" was used during the EMF RI to acknowledge that soils in the EMF Study Area have been affected by anthropogenic activities not related to the EMF facilities, and that background concentrations in the study area should not be considered pristine, unaffected background levels. Representative levels were determined by EPA's risk assessment contractor, E&E, during the EMF RI. The derivation of these levels was documented in the Baseline Human Health Risk Assessment for the EMF Site (E&E, 1997). For the purposes of the following discussion, representative levels and background levels have the same meaning and are used interchangeably.

Constituents of Concern (COCs) and Constituents of Potential Concern (COPCs) within each RU are identified in Table 6-1. COCs are constituents confirmed to be present in a RU based on sampling results and/or process knowledge. The presence or absence of COPCs within specific RUs has not been confirmed. For RUs with a remediation vision that includes a cap/cover, investigation of COPCs is not identified as a data gap because the envisioned remedial action will meet RAOs for the COPCs as well as COCs present within these RUs. For RUs with a remediation vision of no further action anticipated to be necessary, the SRI scope will include sampling for COPCs. Details of each investigation will be provided in the SRI Work Plan.

EPA selected remedies for the Calciner Solids Storage Area (RU 16), the Old Phossy Ponds (RU 22b), and the Railroad Swale (RU 22c) in the 1998 ROD. EPA subsequently elected to reconsider the 1998 ROD; consequently, implementation of these remedies was stayed pending EPA's further review.[1] FMC believes that these areas continue to warrant remedial action. As a result, these areas were evaluated to determine if there have been any significant changes since the EMF remedial investigation that would bring into question the appropriateness of the remedies selected in the 1998 ROD, and if so, whether additional characterization is appropriate prior to reevaluating these areas for remedial action during the SFS process.

EPA's Data Quality Objectives (DQO) process (EPA 2000) was used to evaluate each RU. At some of the RUs, FMC anticipates implementing a presumptive remedy of containment, and the DQO procedure was reformatted to follow EPA's Technical Areas for Presumptive Remedies of

CERCLA Municipal Landfills (EPA 1995) for landfill-like units or similar wastes. At RU 16 and RU 22b, FMC anticipates implementing the remedy selected for that area in the 1998 ROD.

FMC also anticipates implementing the 1998 ROD remedy selected for groundwater. Groundwater impacts, flow patterns, flow rates, source areas, and fate and transport were characterized during the EMF RI. Subsequent monitoring has supported the conclusions drawn in the EMF RI (Sections 3.3, 4.4 and 5). FMC will continue the voluntary CERCLA

[1] Further review of potential remedial action technologies is available in Treatment Technologies for Historical Ponds Containing Elemental Phosphorus – Summary and Evaluation (EPA 2003). This document is also referred to as the EPA TIP Report.

exposure to pond solids. However, some downward migration of metals may have occurred during operation of the calciners because there is a potential for leaks in the subsurface piping and sumps. These facilities no longer contain water associated with the calciner scrubber system, and are no longer potential sources of infiltration.

Although there is no indication the kiln ponds contain or stored P4, there is evidence from the RI that the ponds were a source of heavy metals to groundwater. Boring F054B, drilled in the area of the former kiln scrubber overflow pond, showed that site-related constituents had migrated from the base of the pond to the silt aquitard overlying the uppermost aquifer. Specifically, cadmium, zinc, and arsenic were found at above-representative levels in soil samples collected from the silt aquitard overlying the uppermost aquifer. The silt aquitard beneath RU 8 and RU 9 was characterized as part of the overall hydrogeologic investigation of the EMF RI (see sections 3.1, 3.3, 4.4, 5, and Appendix K of the EMF RI, BEI, 1996). In the area of RU 8 and 9, the aquitard is generally flat-lying, with a vertical permeability of approximately 10^{-6} cm/s.

Since 1994, there have been no changes at the former kiln scrubber ponds. Calciner #2 remained in service from 1994 until plant shutdown in 2001, with no process changes that would have impacted the underlying former kiln scrubber pond residuals.

The 1998 ROD did not select a remedy for these ponds. However, the ROD selected a capping/cover remedy for the similar calciner solids stockpile and the ponds in the western area of the FMC Plant OU.

Given the similarities between kiln solids and calciner solids, the remedy selected in the 1998 ROD for the calciner solids stockpile (see RU 16, below), likely could be effectively applied at RU 8.

Data Gaps

The only data gap is confirmation of the lateral extent of kiln scrubber pond sediments. The SRI scope will include up to six shallow borings or trenches along the exterior boundary of RU 8 to ensure the area proposed for a cap/cover encompasses the lateral extent of residual kiln scrubber solids.

RU 16 – Calciner Solids Stockpile:

The following discussion is summarized in Figure 6-9. The remediation vision for RU 16 is to implement the remedy selected in the 1998 ROD. The remedy selected was grading and installing a soil cover to prevent exposure to the calciner solids. The grading plan would include provisions for managing storm water run-on and runoff to reduce infiltration through the waste mass.

The EMF Remedial Investigation Report (Bechtel, 1996) identified two calciner solids storage areas – Storage Area A (associated borings F023B, F050B and F128B) and Storage Area B (associated borings F051B and F127B). FMC believes that the location of boring F127B is mis-plotted on RI Report Figure 2.1-1 and was located northwest of boring F051B and within the footprint of Storage Area B. This conclusion is based on the lithologic description of the surficial material in Boring F127B that show approximately 5 feet of calciner solids present. The plotted location is located on the reject ore pile within RU 15, indicating that F127B was not drilled in that location. A detailed description of SWMU 17 (Storage Area B) and SWMU 1 (the calciner solids stockpile, aka Stockpile Area A) can be found in the EMF RI Report (pages 4.2-161 through 4.2-165).

After completion of the 1996 Remedial Investigation, FMC constructed a new double-lined calciner solids solar drying pond (designated Calciner Pond 5C) at the location of Storage Area A. During construction of Calciner Pond 5C, any calciner solids and visibly contaminated soil within the planned footprint of the new pond (including solids and soils at the locations of borings F023B, F050B and F128B) were removed down to native soil (a depth of approximately 15 feet). The majority of these solids and soil were moved to the location of Storage Area B (in RU 16). Based on visual inspections at RU 15, it appears that a minor portion these materials were placed within RU 15 as well. Following placement of the removed solids and soil at Storage Area B, FMC placed about 1 foot of soil cover over the Storage B area (Figure 6-10a). Thus, Storage Area A - as described in the RI Report - no longer exists. The calciner pond solids and contaminated soil from Storage Area A are now beneath and within the area that is being addressed by the Calciner Pond Remedial Action Plan (under the Consent Order between FMC and IDEQ for remedial action at the calciner ponds).

The northern boundary of RU 15 is a common boundary with the southern boundary of the Calciner Pond Remedial Action area. As described above, a minor amount of materials from Storage Area A remain within RU 15, but a majority of these materials were placed in Storage Area B, within RU 16.

After Calciner Pond 5C became operational, the excess solids from this pond were removed and placed in the southern "half" of RU16, also referred as SWMU 16 (Figure 6-10).

The northern "half" of RU 16 consists of calciner solids originally dredged from the old calciner ponds and then excavated as part of the removal of Storage Area A during construction of Calciner Pond 5C. The southern "half" of RU16 consists of dried calciner pond solids periodically removed from Calciner Pond 5C during plant operation from 1995 through 2001. RU 16 only received calciner solids and some soil mixed with the solids removed from former Storage Area A and the soil cover placed over Storage Area B.

Since 1996, there were no changes to the calcining process. For example, construction and operation of the excess CO combustor in 2001 did not materially affect the calcining process. Thus, the materials placed on the stockpile after 1996 essentially were the same as those placed before that date.

Although the volume and areal extent (footprint) of calciner solids within RU 16 has increased since the 1998 ROD, the materials themselves have remained consistent in terms of their chemical and physical characteristics. Figure 6-10a illustrates the current extent of the calciner solids and also shows the area where soil has been placed over a portion of the calciner solids stockpile.Soil data from F051B and F127B do not support a definitive conclusion on the vertical extent of contamination beneath Storage Area B (SWMU 17). There are no soil borings in the southern portion of RU 16 to characterize the vertical extent of contamination.

Data from F051B indicate migration of contaminants to depths in excess of 14 feet (deepest sampled interval). Whereas F127B indicated that metals did not migrate deeper than 5 to 10 feet into native soils (EMF RI Report . Table 4.2.3-33 and page 4.2-164).

Data Gaps

Although the 1998 ROD indicated that the primary objective of the calciner solids stockpile cap/cover was to prevent exposure to these materials, there remains some uncertainty regarding the mobility of metals in the calciner solids. The SRI will address this uncertainty by collecting additional source characterization data to support the type of cap/cover selected for RU 16. For example, if the SRI data indicate that metals in the calciner solids have a very low leachability potential, a soil cover may be sufficient. On the other hand, if testing of the calciner solids indicates metals are leachable to the extent that groundwater quality may be impacted above relevant MCLs and RBCs, a cap that further reduces infiltration may be appropriate.

Leachability testing on randomly selected composited grab samples should characterize the leaching potential of the material. Materials in SWMU 17 and SWMU 16 will be characterized separately because SWMU 17 received a mixture of calciner solids and soils, whereas SWMU 16 received only calciner solids from Pond 5C.

Characterization of the vertical extent of contamination within RU 16 is also a data gap. Evaluation of available groundwater data will be performed prior to issuing the SRI Work Plan. Results of this evaluation will be included in the Work Plan to help justify whether or not additional soil borings are needed.

6.1.2 Former P4 Working Areas

Key points for considering remedial alternatives at the former P4 working areas are the delineation of P4 in the subsurface, mobility of P4, and the existing cover over P4 areas. The delineation of P4 poses unique challenges due the physical and chemical properties of P4. Specifically, P4 is a liquid at temperatures above 44 C and freezes (i.e., becomes solid) below that temperature and is essentially immobile in the subsurface. The P4 was maintained in a liquid during the majority of the manufacturing and handling processes at the plant. P4 was handled at temperatures typically in the range of 60 to 66 C while being transferred (i.e., displaced with water or pumped) between product vessels/tanks and for railcar loading. In the event of a P4 release, it would be released as a liquid, and migrate in the subsurface until it encountered soils with ambient temperatures less than 44 C. Once ambient soil temperatures fall below 44 C, P4 freezes and remains immobile as a solid. Soils beneath the slag pit and furnace building were heated to temperatures above 44 C from the intense heat source of continuous tapping of molten slag into the slag pit, until slag ladling was fully installed in 2000.

FMC has documented P4 releases from certain specific areas and suspects that other historic releases of P4 have occurred in the former P4 working areas. However, determining the exact release points from all the P4 process vessels, waste management units, and related piping would pose significant technical challenges such as drilling through reinforced concrete foundations, and would likely require a very dense grid of sample points. Even if all release points were confirmed and the local extent of P4 could be precisely delineated, the design of a treatment alternative for P4-containing soils would pose technical challenges similar to the potential treatment processes for pond sludges discussed in the EPA's TIP report (EPA, 2003).

An important consideration relating to the former P4 working areas is that FMC has already removed the majority of P4 in the process equipment, and is committed to the removal of all remaining P4 from process equipment, including P4 in subgrade sumps and other vessels. This P4 is being recovered for sale or off-site disposal (if it does not meet the quality standards for sale). When P4 removal from process equipment is complete, there will be no remaining

In order to consider hotspot removal and treatment, the following questions must all be answered in the affirmative (EPA, 1993):

- Is there evidence for the presence and approximate location of waste?
- Is hotspot known to be a principal threat waste?
- Is the waste in a discrete, accessible part of the landfill?
- Is the hotspot known to be large enough that its remediation will reduce the threat posed by the overall site, but small enough that it is reasonable to consider removal (100,000 cubic yards or less)?

EPA recognizes the potential hazards and technical difficulties associated with characterizing wastes in a landfill. EPA states: "Characterization of a landfill's contents is not necessary or appropriate for selecting a response action for these sites except in limited cases; rather, existing data are used to determine whether the containment presumption is appropriate.... It is important to note that the decision to characterize hot spots should also be based on existing information, such as reliable anecdotal information, documentation, and/or physical evidence (see page 6)." (EPA, 1993).

The existing data regarding waste characterization in FMC's landfills are summarized in Table 6-3.

Technical Area 1 – Waste Area Delineation

The delineation of all three landfills has been performed by reviewing historic air photos to confirm that waste management has not occurred outside the current boundaries, and to determine the boundaries of the former plant landfill beneath the slag pile. At RU 17 and RU 18, the landfill areas have been delineated visually by confirming the extent of the disturbed soils and extent of past excavation.

FMC will continue to dispose unrecyclable construction materials in RU 18. FMC will continue operation of the RU 18 landfill until completion of plant dismantling. RU 17 will no longer be used for disposal of construction material. At this time, FMC anticipates there is sufficient space within the current RU boundaries to contain any unrecyclable construction materials generated during plant dismantling. (SC #82)

~~The footprint of RU 17 and RU 18 may be extended during FMC's plant decommissioning and demolition activities. FMC anticipates that a significant volume of material generated during demolition will be hauled offsite and sold as scrap, or reclaimed for commercial value. Material that has no value as scrap will be landfilled in the area between RU 17 and RU 18 (Figure 6-17).~~

The Former Plant Landfill within RU 19 has been inactive and buried with over 40 feet of slag since the late 1960's or early 1970's. The timing of burial is difficult to pinpoint, but the 2003 air photo clearly shows the entire former landfill area seen in the 1965 air photo is covered with slag (Figure 6-20).

RU 19 also contains approximately 17 buried rail cars. These rail cars were filled with sludge in 1964 and hauled up to the slag pile (Figure 6-19). The rail cars are an older generation of tank cars, approximately 30 feet long (compared to 50 feet long for later generation tank cars), and 9.5 feet wide. RU 19 also encompasses the former plant landfill (Figure 6-21).

potential in other parts of the FMC Plant OU. Surface water management is a design issue that will be addressed in the SFS or RD/RA phase.

Technical Area 6 – Cover Material Characterization

As noted in Technical Area 4, the soil used for RCRA caps at FMC has been characterized, and this same material would be used for the soil covers at the landfills.

The permeability data are summarized in Table 6-4.

Technical Area 7 – Hotspot Removal and Treatment

The criteria used to evaluate the feasibility for hotspot removal within a landfill are summarized against the information for each landfill. Included in this summary are the buried rail cars within RU 19, because the presumptive remedy of containment appears to apply to the sludge contained in the rail cars.

As shown in Table 6-5, the criteria are not met. A negative response means that hotspot remediation should not be considered as part of the presumptive remedy. And all the landfills within the FMC Plant OU should be considered for containment without hotspot removal.

Further supporting a containment remedy for the buried railcars is the fact that they contain P4-containing sludges. The EPA's TIP report concluded that treatment of these sludges is not technically feasible, and a containment remedy is the most suitable alternative. Even if the railcars could be excavated and removed, treatment of the sludges would not be feasible.

Summary

A summary of the RI/FS Technical Areas for the FMC Plant OU landfills is presented in Table 6-6.

FMC has identified an FS data gap associated with radon emission rates through a soil cover on the slag pile. Radon flux measurements will be collected during the SRI to support the SFS.

FMC will also review the existing geochemical and hydrogeologic data as part of the SRI. This review is intended to address uncertainties associated with groundwater flow directions in the area of the slag pile, former plant landfill, and buried railroad cars.

6.1.4 Other Remediation Units

This section discusses the RUs that are not classified as Old Ponds, Landfills, or Former P4 Working Areas. The RUs discussed in this section include:

- RU 3 – Receiving Stores, Paint Shop, and P4 Decon
- RU 4 – Office Buildings and Training Center
- RU 5 – Lab and Old Drainfield
- RU 7 – Shale Unload, Crushing and Stockpile
- RU 9 – Silica Stockpiles and Former Kiln Scrubber Overflow Pond
- RU 10 – IWW Pond and Ditch
- RU 11 – Equipment Area South of Calciners
- RU 12 – Former RP&S Area and Mobile Shop

As noted for RU 3, there is no evidence that phossy solids were disposed or stored within RU 4; however, the XRF screening method described in Appendix H will be performed during the SRI.

RU 5 – Lab and Old Drainfield

The discussion of RU 5 is summarized in Figure 6-27. The remediation vision for RU 5 is "no further action anticipated to be necessary".

SWMU #61, the disposal area behind the laboratory, is also located within the RU 5. This area has been identified as a potential source for solvents and metals. There may have been some disposal of free liquids in this area, which is now covered with sidewalks and a parking area.

The EMF RI targeted the laboratory seepage pit at RU 5 as a potential source of inorganics and VOCs (Figure 6-25). The seepage pit received laboratory acids and solvents used in the preparation of ore samples for analyses. In 1980, the disposal of laboratory waste ceased, and in 1995 FMC grouted the seepage pit to prevent migration of any remaining metals or solvents.

A review of the site history since the 1998 ROD was signed did not identify additional or new potential sources at RU 5.

Statistical Summary

Only one soil sample was available within the depth intervals of concern (0-10'). Therefore, no statistical analyses could be performed.

Data Gaps

Gamma radiation measurements are needed at RU 5 to support the decision for no further action. The number of gamma measurements will be detailed in the SRI Work Plan through the application of the DQO Process. The XRF screening method described in Appendix H will be applied to RU 5 to confirm that lead-210 and polonium-210 are not above levels of concern in RU 5.

Although the EMF RI did not identify the disposal area behind the lab as a potential source to groundwater, additional characterization is needed for VOCs and SVOCs in the shallow soils in order for redevelopment to occur in this area. If VOCs and/or SVOCs are detected, limited hotspot remediation will be evaluated in the SFS. VOC and SVOC potential impacts to groundwater may need additional investigation, depending on the results of the hotspot investigation.

Last, additional soil samples are needed to characterize inorganic contaminants at RU 5 to support the remedial action vision through the DQO process.

RU 7 – Shale Unload, Crushing and Stockpile

The Shale Unload, Crushing and Stockpile area has been used for the same purpose since the plant began operation (Figure 6-28 and 6-29). Although material handling practices have changed (e.g., ore was originally handled with bulldozers, and later with the stacker/reclaimer wheel), the material stored within the boundaries of RU 7 has always been ore.

The source for the ore has been the Phosphoria Formation from two mines in the region. The Gay Mine was the source of ore from 1949 through 1993, and Dry Valley Mine was the ore source since 1993.

Construction Worker RBC, as does arsenic at the 95% confidence level. There are insufficient data to compare site concentrations against Construction Worker RBCs for antimony, fluoride and lead.

Cadmium concentrations exceed the Utility Worker RBC, while none of the other inorganic constituents exceed the Utility Worker RBCs.

Data Gaps

The data gaps that will be addressed in the SRI are gamma radiation measurements; shallow site soils (0-10') for inorganics; and the potential for P4 occurrence along the underground piping in the eastern portion of RU 13.

In addition, confirmation sampling will be conducted around Borings F058B and F059B to determine the extent of the phossy solids at depth, and selected samples will be analyzed for lead-210 and polonium-210.

RU 15 – Oversize Ore, Used Electrode, Baghouse Dust Area

The following discussion on RU 15 is summarized in Figure 6-39, and the site is shown on Figure 6-40. The northern boundary of RU 15 has a common boundary with the southern boundary of the Calciner Pond Remedial Action area. RU 15 was primarily used since the 1970's for storage of oversize ore, calcined nodules, baghouse dust from ore handling facilities within the plant, and used carbon electrodes from the furnaces. The EMF Remedial Investigation Report (Bechtel, 1996) identified a calciner solids storage area, identified as Storage Area A (associated borings F023B, F050B and F128B).As noted in the discussion for RU 16, there are some residual calciner solids within RU 15. More recently RU 15 has received residual coke and silica.

Currently, RU 15 has surficial calciner solids as well as oversized ore, calcined nodules, baghouse dust, and minor amounts of silica and residual coke. Several pieces of broken carbon electrodes are also located in RU 15.

Periodically, FMC would reclaim some of the oversize ore. The larger portions of electrodes were periodically sold. FMC has sampling data indicating there was no P4 within the carbon matrix before selling the electrodes.

FMC's remediation vision of grading and capping RU 15 is focused on reducing the potential exposure to surficial calciner solids, ore, calcined solids, and baghouse dust, and controlling run-on/run-off to prevent migration via surface water runoff. EMF RI data from the RU 7 area (shale ore stockpile area) and other ore feedstock data indicates the material in RU 15 (ore and baghouse dust from ore handling facilities) exceed the RBCs for arsenic and possibly cadmium. Furthermore, the EMF RI borings in the RU 7 area also showed that the metals and inorganic constituents within shale are immobile and do not readily leach from the ore when exposed to precipitation (EMF RI Report, pages 4.2-125 through 4.2-128).

Boring 163B was initially drilled to install a groundwater monitoring well. However, water-yielding material was not encountered. A single sample from a depth of 21 feet was analyzed for selenium. Results for this analysis were ND (1.4 mg/kg UJ). This information was not discussed in the RI Report, but was submitted to EPA during the RI.

Statistical Summary:

There were insufficient soil samples to perform a statistical comparison between site soils and RBCs or background.

Data Gaps

The ore and calciner solids stored within RU 15 were characterized during the EMF RI. However, these site-specific materials have not been adequately characterized to support the SFS. FMC will test the ore, calciner solids and coke for leaching potential. This information will be used during the SFS to support cover/cap design criteria.

Characterization of the vertical extent of contamination within RU 15 is also a data gap. Evaluation of available groundwater data will be performed prior to issuing the SRI Work Plan. Results of this evaluation will be included in the Work Plan to help justify whether or not additional soil borings are needed.

RU 21 – Other Onsite Railspurs

Figure 6-41 summarizes the discussion on RU 21, shown in Figure 6-42. The railspurs that are not within the boundaries of other RUs were identified as potential sources of gamma due to the presence of slag fill. These railspurs do not include the locations of loading and unloading activities; these are addressed as noted in other RUs.

The railspurs were built to support plant operation. Once constructed, the locations have not changed through time. Slag fill was used as railspurs required maintenance and upgrading through the years. FMC received coke at RU 20 and RU 7, slag was loaded onto railcars within RU 20, and ore was unloaded at RU 7. P4 was loaded and unloaded within the boundaries of RU 1 and RU 6. The remaining railspurs were used for railcar staging. Within the boundaries of other RUs the specific materials handled along the railspurs are subject to investigation within these RUs.

The railspurs remain a key infrastructure component for most site redevelopment options, and FMC has no plans to remove the railspurs.

Statistical Summary

No statistical analyses were performed for inorganic constituents within RU 21 because there were insufficient data.

However, an analysis of the slag data (see Appendix C: RU 20) shows that slag does not contain inorganic constituents that exceed the updated RBCs at the 95% UCL. Beryllium concentrations exceed the 1998 RBCs, but the 95% UCL of the mean for beryllium does not exceed the updated RBCs for future site workers, construction workers, and utility workers.

Data Gaps

The EMF RI identified the presence of slag along most railspurs at varying thickness. Because slag is a known gamma source, the scope of the SRI will include characterization of gamma radiation along the RU 21 railspurs.

RU 23 – Road Segments not included in other RUs

Figure 6-43 summarizes the following discussion relating to RU 23. Road segments that do not fall within other RU boundaries can be seen in Figure 3-1. The rationale for classifying road

Table 6-1 - Constituents of Concern in each Remediation Unit

RU No.	RU Name	Parameters									Information Basis
		P4	Ra-226[a]	Arsenic	Cadmium	Solvents[b]	Liquid Petroleum Fuels[c]	PCBs	Lead-210[d]	Other	
RU 1	Furnace Building	COC	COC	COPC	COPC						P4 encountered under foundation of furnace building during slag ladling conversion project (No. 3 furnace P4 sump). Occurrence within other areas anticipated based on process knowledge and spill assessments.
RU 2	Slag Pit	COC	COC	COPC	COPC						Process knowledge
RU 3	Receiving Stores, Paint Shop, and P4 Decon	COC	COC								Process knowledge, EMF RI
RU 4	Office Buildings and Training Center		COC								EMF RI
RU 5	Lab and Old Drainfield		COC			~~COPC~~ COC					EMF RI
RU 6	Former Long-Term P4 Storage	COC	COC						COPC		EMF RI and post-RI spill history.
RU 7	Shale Unload, Crushing and Stockpile		COC	COC					COPC		Process knowledge, EMF RI
RU 8	Former Kiln Scrubber Ponds and Calciners		COC		COC				COPC		Process knowledge, EMF RI
RU 9	Silica Stockpiles and Former Kiln Scrubber Overflow Pond		COC		COC				COC		EMF RI
RU 10	IWW Pond and Ditch	COPC	COC						COPC		EMF RI and post-RI spill history.
RU 11	Equipment Area South of Calciners		COC						COPC		Process knowledge, EMF RI
RU 12	Former RP&S Area and Mobile Shop	COC	COC	COC	COC		COPC	COPC	COPC		EMF RI, post-RI spill history, LDR pre-construction soil sampling.
RU 13	Pond 8S Recovery Process & Metal Scrap Preparation Area	COC	COC	COC	COC				COPC		Process knowledge, EMF RI
RU 15	Oversize Ore, Used Electrode, Baghouse Dust Area		COC	COC	COC				COPC		Process knowledge, EMF RI
RU 16	Calciner Solids Stockpile		COC		COC				COC		EMF RI
RU 17	Recyclable Material Landfill								COPC	See Table 6-3, landfill contents	Process knowledge.
RU 18	Plant Landfill					COC	COC		COPC	See Table 6-3, landfill contents	Process knowledge.
RU 19	Slag Pile, Bull Rock Pile	COC	COC	COC		COC	COC		COPC	See Table 6-3, landfill contents	EMF RI, process knowledge, historic aerial photo review.
RU 20	Former Bannock Paving Area		COC			COPC	COPC				EMF RI and post-RI spill history.
RU 21	Other Onsite Railspurs		COC								EMF RI
RU 22b	Old Ponds	COC		COC	COC				COC		EMF RI
RU 22c	Railroad Swale	COC									EMF RI and post-RI spill history.
RU 23	Road segments not within RU Boundaries		COC						COPC		Process knowledge, EMF RI

COC – Constituent of Concern. Evidence of presence in a specific RU based on EMF RI data, process knowledge, post-RI spill history, or other line of evidence

COPC – Constituent of Potential Concern. Potential presence, not confirmed

[a] Gamma radiation measurements will be used as a surrogate to quantify primary risks associated with Ra-226 (ie, external gamma exposure) in RU's where a cap/cover is not envisioned

[b] Includes TCE, PCE, Chloroform, 2-Butanone, and 1,1,1 TCA

[c] Includes benzene, toluene, ethylbenzene, and xylenes

[d] Lead-210 and Polonium-210 are known to occur in precipitator dust and phossy solids. XRF methodology outlined in Appendix H will be used for characterization.

RU 6 Summary	
RU Description	FMC installed 12 underground steel storage tanks for additional storage of P4. The tanks were two sizes, 104,000 gallons and 52,000 gallons. Tanks were filled by transporting P4 in railcars from the Phos Dock, so there is no underground P4 piping leading to RU 6. Pumps in the tanks were used to load the P4 onto railcars when the P4 was sold. The RU is located on a fairly level area of the FMC plant, and it is bounded by roads on the south and east, and a railroad spur line along the northeast. No underground process pipelines are near or within the RU boundaries.
EMF ROD Remedy	The 1998 ROD selected site-wide institutional controls to prohibit residential use and prevent ingestion of groundwater exceeding MCLs/RBCs. The ROD also selected site-wide institutional controls requiring future structures be constructed with radon control measures.
EMF RI Findings	P4 was not encountered in either of the soil borings drilled in RU 6. Some inorganics were detected at above-representative levels. Maximum depth investigated was 7 feet. Borings did not encounter slag, ore, or precipitator dust.
RI Update: Current status; post EMF RI data; additional sources; COPCs	In 1994, FMC removed eight tanks and backfilled the excavation. In 1998, the last four tanks were removed. During both phases of tank closure, FMC collected samples from the native soils within the excavation to confirm that all soil and tank backfill containing P4 was removed during closure.
Remediation Vision	No action anticipated to be necessary.
Do existing data support remediation vision in context of updated CSM?	No. See Data Gaps below.
Data Gaps	Insufficient data to characterize inorganics in the 0-10~~6~~' depth interval. Confirmation sampling at railcar loading/unloading area for P4 Confirmation sampling around tank pit for P4 Gamma radiation measurements to characterize slag fill.
CONCLUSION: Forward to SRI for P4 confirmation sampling, gamma radiation measurements, and characterization of inorganics, lead-210 and polonium-210 in 0' to 10' depths. Note: Lead-210 and polonium-210 are radionuclides associated with phossy solids. Phossy solids may be detectable through the use of surrogates, as described in Appendix H.	

Figure 6-14

RU 6 Summary

RU 15 Summary	
RU Description	RU 15 is located south of the calciner ponds, in the Bannock Range area. It is south of the main plant area, and east of the slag pile, near the FMC property boundary with Simplot. It contains mounds of reject ore (similar to the bull rock pile in RU 19), and baghouse dust. The dust originated from raw material handling, such as ore and coke unloading from rail cars. There are some smaller pieces of used or broken carbon electrodes. Larger pieces of carbon electrodes have been sold.
EMF ROD Remedy	The 1998 ROD selected site-wide institutional controls to prohibit residential use and prevent ingestion of groundwater exceeding MCLs/RBCs. The ROD also selected site-wide institutional controls requiring future structures be constructed with radon control measures.
EMF RI Findings	The EMF RI identified EMF-related constituents in the shallow native soils immediately underlying the ore. There was no evidence that these constituents were migrating to groundwater. Ore contains cadmium, chromium, vanadium and zinc at concentrations above background soils, as well as fluoride and phosphorus.
RI Update: Current status; post EMF RI data; additional sources; COPCs	The larger pieces of carbon electrodes have been sold and were removed from the site, after confirmation sampling of the electrodes was performed. RU 15 no longer receives ore, baghouse dust, and other materials for disposal/storage.
Remediation Vision	Consolidate material into minimal footprint, grade to design subgrade elevation and construct soil cover (cap) over area.
Do existing data support remediation vision in context of updated CSM?	No. Leachability testing of the various materials stored in RU 15 is needed to support cover\cap design.
Data Gaps	None.
CONCLUSION: Forward RU 15 to SRI	

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Deleted: Ore, baghouse dust, and remaining pieces of carbon electrodes can be effectively removed from exposure pathways through implementation of the remediation vision. No other data are required to support the SFS or RD

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Figure 6-39

RU 15 Summary

APPENDIX D
REVISIONS
REDLINE/STRIKETHROUGH

APPENDIX D

GEOTECHNICAL LABORATORY RESULTS FROM COVER/CAP BORROW AREA

FMC IDAHO LLC

NOTE: These laboratory reports and the results/data contained therein are provided for information only. Approval of the RI Update Memo does not constitute approval to FMC or others as to the suitability of the tested materials/soils for use in landfill caps or covers.

APPENDIX E
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following data gaps that will be addressed during the SRI to provide data for cap design during the SFS:

- o Leachability testing of calciner solids (RU 16) to support designing a cover that sufficiently minimizes infiltration;
- o 44°C isotherm modeling study and confirmatory soil sampling at RU 1 and RU 2 to ensure that the area to be capped has been adequately identified; and,
- o Radon flux measurements from the former phossy waste ponds will be obtained for evaluation of the pond covers relative to the UMTRCA guideline of 20 pCi/m^2s.

The remainder of this response provides FMC's rationale for limiting the data gaps to those listed above. The following information is presented for information only, and will be more fully developed in the SFS.

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The design of the RCRA pond caps was based first on meeting four primary performance criteria and then took into consideration the volume, moisture content, and P4 level of the sediments to develop a design based on the longevity of the cap deemed appropriate to minimize infiltration and isolate the wastes from direct contact. The primary cap design criteria (RAOs) were developed in the FS Report (1997). The four primary design criteria (or remedial action objectives) for these RCRA closures were:

- Long-term minimization of the migration of liquids through the closed impoundment;
- Function with minimum maintenance;
- Promote drainage and minimize erosion or abrasion of the cover; and
- Install a cap with a permeability less than or equal to the permeability of any pond liner or natural subsoils.

Closure of Pond 8S began in 1994 with the concurrent placement of an initial sand and slag fill and drawdown of the free liquids overlying the phossy waste sediments within the pond. The closure plan called for installing a final cover over the initial fill after the settlement rate of the pond sediments and backfill was reduced to design objectives. The initial design for the final cover at RCRA Pond 8S was a 3.5-foot thick multi-layer cap, based on the design recommended in EPA guidance. FMC believed that the combination of initial fill and a multi-layer RCRA cap collectively met RCRA design criteria for pond closure.

Based on FMC's experience and published research, elemental phosphorus (P4) within the pond solids mixed with water, including nearly saturated conditions after removal of free water and placement of the cap, would remain in the covered sediments for some time. EPA was concerned that the synthetic components in the multi-layer cap could not be demonstrated to have sufficient longevity to meet the performance standards over an extended period. Based on EPA's concern, FMC proposed integration of a capillary-barrier cover above the synthetic layers of the originally proposed 3.5-foot multi-layer cap. The capillary barrier was designed exclusively with natural earthen materials to minimize infiltration, withstand erosive forces over an extended period, and ensure that the cap meets the performance standards over the long-term, independent of the longevity of the synthetic layers. In addition, a biointrusion layer (an 18–inch thick layer

- Soil and well borings demonstrate the absence of P4 over large areas of the old ponds. Of the 31 soil and well borings advanced within the footprint of former unlined phossy waste ponds, all but one (F037B) encountered slag fill over a 1 to 4-foot thick layer of oxidized pond solids (slightly moist or dry) or slag fill over native soils (suggesting that phossy solids had been removed or had not accumulated). F037B was advanced through 20 feet of slag fill before encountering elemental phosphorus at 23.5 feet bgs.

- Soil and well borings also demonstrate the absence of free liquids within the residual sediments. Former unlined phossy pond sediments have been either exposed or covered with slag (slag is permeable) for decades, except where the former pond is overlain by a newer, lined RCRA phossy waste management pond. Exposed or slag covered phossy wastes would not be expected to contain free liquids and the majority of P4 would have been oxidized to below the 1,000 ppm smoking level.

- Groundwater monitoring data obtained over more than the last 10 years shows that oxidizing conditions (higher Eh levels) are encountered in wells within and downgradient from the former unlined phossy waste ponds (RU 22b). For example, samples from Well Pair 133/134, downgradient from the former unlined phossy waste ponds, consistently exhibit positive Eh values. ~~**This indicates that most of the P4 that may have been contained in the pond sediments has been oxidized, and there is not a significant mass of P4, if any, remaining in these sediments.**~~ Reducing conditions (strongly negative Eh levels) are encountered only in wells 150, 152, 155, 156 and 157 downgradient from Pond 8S. ~~**These strongly reducing conditions are indicative of a reducing leachate flux from reduced conditions in the phossy wastes that have undergone little if any oxidation, including P4 in the pond sediments.**~~

In summary, about half of the old phossy ponds have little or no remaining pond sediments, none of the ponds contain free water or even saturated sediments, and P4 levels in residual pond sediments are estimated to be below 1,000 ppm in all of the seven "E-series" ponds, as well as in six of the eleven "S-series" ponds within RU 22b.

See Table G6.

2. **Section 2, Figure 2-10: Conceptual Site Model for Potential Human Exposure to Contaminants at the FMC Operable Unit**

The CSM must be updated to include not only slag, but other waste materials such as precipitator dust and calciner fines that have been used as fill.

FMC Response:

Please see the revision to Figure 2-10.

Deleted: Please note, however, that neither precipitator dust nor calciner fines were used as construction fill. Rather, precipitator dust was occasionally spread on internal plant roads during winter conditions as a means to enhance vehicle traction. Calciner fines have been placed in unlined stockpiles south of the Calciner Ponds.

3. **Section 2, Figure 2-10: Conceptual Site Model for Potential Human Exposure to Contaminants at the FMC Operable Unit**

This figure must be modified to include infiltration/percolation as a possible primary release for areas operated without sustained hydraulic head. As stated in Specific Comment #10, this release mechanism depends on the timing and magnitude of infiltration, the magnitude and extent of the contaminant source term, the nature of the contaminant, and the hydraulic properties of the vadose zone. For many of the sites, this mechanism may be slow given site conditions and the nature of contaminants present, so no adverse impacts to groundwater are likely to occur. These issues must be described in the text.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004. In the proposed revisions, FMC recognized several potential sources to groundwater where a sustained hydraulic head was not applied. These changes are reflected in the CSM and in the text of Section 2 and Appendix A.

4. **Section 2, Figure 2-10: Conceptual Site Model for Potential Human Exposure to Contaminants at the FMC Operable Unit**

Former plant landfill (RU 19) does not appear to be listed and must be included under Primary Sources in the CSM.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004. The Former Plant Landfill in RU 19 has been added to the CSM as a primary source.

5. **Section 2, Figure 2-10: Conceptual Site Model for Potential Human Exposure to Contaminants at the FMC Operable Unit**

It is unclear why infiltration/percolation has been removed as a secondary release mechanism for areas operated with sustained hydraulic head. If the CSM has been drawn to take account of the remedial actions already in progress at these sites, data has not been presented to demonstrate that the remedies are fully effective at preventing contaminants in the vadose zone from migrating to the aquifer. The document must be revised to include the potential secondary

However, FMC believes that the extrapolation of Montana data to radium-226 activities in FMC slag is inconsistent with analytical data. In EPA's 1977 study of radionuclides in FMC's feedstocks, byproducts, and waste materials (cited in the response to EPA General Comment 3 and 4), uranium-238 activities ranged from 18.6 to 29.4 pCi/g, and radium-226 activities ranged from 22.8 to 33.3 pCi/g. Gross alpha activities in slag samples were not determined in EPA's study. However, summation of alpha activities for the alpha-emitting radionuclides in slag samples analyzed by EPA results in gross alpha activities ranging from 162 to 229 pCi/g.

Uranium-238 activities in FMC slag samples analyzed during the EMF RI ranged from 22.1 to 30.7 pCi/g, and gross alpha activities in these slag samples ranged from 179 to 240 pCi/g. The similarity of uranium-238 activities between EPA's data and FMC's data, the actual radium-226 activities detected in EPA study, and the similarity in actual and calculated gross alpha activities indicates that the radium-226 activities extrapolated from the Montana data are not characteristic of FMC's slag. Moreover, it is unlikely that 50% of the gross alpha activity in the Montana slag would be attributable to radium-226. One should ask if the contribution to gross alpha from other alpha-emitting radionuclides in the uranium-238 decay series (such as U-234, Th-230, Po-210) were considered in reaching the cited conclusion. Perhaps some or all of these other radionuclides were not reported in the Montana data.

The decay of a Ra-226 atom would contribute 4 alpha particles (Ra-226 itself plus its short-lived alpha-emitting daughter products Rn-222, Po-218, Po-214) toward a gross alpha measurement. Without knowing the gross alpha activity of the Rhodia slag sample, we cannot estimate the Ra-226 activity. However, given the previous factor, it is more likely that the Ra-226 activity in the Rhodia slag is approximately 25 pCi/g rather than 100+ pCi/g.

8. Section 2, Table 2-4, Comment 5, Comment Set 2

Table 2-4 provides responses to EPA comments on the draft outline for the updated CMS. The response to comment 5 is inadequate because stormwater and sewer pipelines are not included in any RUs or the CSM. The document must be updated to include these items.

FMC Response:

Table 2-4 has been revised to show the storm drain in RU 3 and phossy water piping in RU 2 as potential release points in the CSM.

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The RU's with underground process piping and sewer lines were discussed in Section 6 of the RI Update Memo. These features were identified as potential sources and the associated data gaps sections identify the need for additional data to characterize these features. Specifically, RU 1, RU 2, RU 12, RU 13, RU 3 (storm drain), and RU 22b had associated data gaps relating to underground piping. FMC proposed removal or capping the underground piping, depending on the RU. For RU 3, FMC has proposed a video survey of the storm drain.

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9. Section 2, Page 2-1, last paragraph

The 1998 Record of Decision (ROD) does not restrict land use in the vicinity of the railroad swale. The ROD did not evaluate or discuss the hazard due to elemental phosphorus. Since elemental phosphorus was encountered in this area during the 1991 RI, the railroad swale must

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004. Figure 2-10 identifies "seepage/percolation" to groundwater from RU 1 and RU 2 SWMUs and P4 working areas, including the Phos Dock and Furnace Building. Note that the slag pit wastewater sump was operated with an applied head, and including it in the list of units as having been operated without a sustained hydraulic head would be incorrect.

13. Section 2.2.3, Page 2-9

The wastewater currently treated at the Pond Closure Decant Treatment System (PCDT) water treatment system then used for dust suppression is not discussed in the RI Update Memo. The RI Update Memo must be revised to include the areas where the wastewater was used for dust suppression as potential source areas.

FMC Response:

The PCDT water has been applied to roads within the FMC Plant OU. The December 2004 RI Update Memo identifies road segments within RU's and RU 23 as potential source areas, and identifies associated data gaps for all road segments.

Section 6.1.4, RU 23, has been revised to incorporate a discussion on constituent mass loading to FMC Plant OU roadways resulting from the use of PCDT water for dust suppression.

14. Section 2.2.3, Page 2-10, Groundwater

The document must be revised to state that leaching of contaminants from certain sites without sustained hydraulic heads may also impact groundwater quality.

FMC Response:

These revisions are included in the December 2004 RI Update Memo.

Deleted: This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004.

15. Section 2.2.4, Pages 2-10 & 2-11

For development of SSLs and screening purposes, FMC must use 0-10 ft bgs for the future construction worker scenario. For soil characterization purposes FMC indicates that construction workers engaged in excavations for facility construction projects could be exposed to the upper five to six feet of soil. Justification for this site-specific assumption and deviation from EPA's recommended default exposure parameter soil depth interval for construction worker of zero to ten feet (0-10 ft) below ground surface (bgs) must be provided.

FMC Response:

FMC has revised the Construction Worker Exposure scenario to reflect EPA's default soil exposure depth interval of 0 – 10 feet. Appropriate conforming changes were also made in Sections 4, 6, and Appendix C.

Please also see the proposed changes to text in section 6 submitted to EPA on September 7, 2004. This provides proposed changes to the text to address a data gap on the potential leachability of the calciner pond solids. These revisions are shown in Section 6.1.1, RU 16.

65. Section 6.1.1, Page 6-8, RU 16, 3rd paragraph

The referenced text states contaminants migrated to a depth of at least 10 feet beneath the pile. This is inconsistent with the description found in Table 6-9 which states *that "soil borings show very little if any migration of metals or other EMF-related constituents into native soils beneath the calciner solids."* Provide or reference the actual data (including sample depths and analytes).

FMC Response:

The RI Update Memo has been revised to reflect the history of RU 16 and any conclusions that can be drawn from the available data. The detailed discussion of the data and findings are provided in the EMF RI Report, page 4.2-164 and Table 4.2.3-33 (BEI, 1996). These pages of the EMF RI are cited in the text of the December 2004 RI Update Memo.

66. Section 6.1.1, Page 6-8, RU 16, 3rd Paragraph

The text states that soil data from stockpile borings show that some contaminants have migrated up to 10 feet into the soils beneath the pile. However, neither the text nor Table 6-9 identify the COPCs. Revise the text to provide this information.

FMC Response:

This information has been added at the beginning of Section 6 (see Table 6-1). Please also see response to Specific Comment 59 above.

67. Section 6, Figure 6-10

The text does not describe the differences between SWMU 17 (Storage Area B) and SWMU 1 (Calciner Solids Stockpile) identified in the figure. The text must be revised to describe SWMU 17. The existing data appears to have been taken from roadway areas. It is not clear this existing data adequately characterizes the unit. The results of samples collected in the roadways may not be representative of conditions found within the stockpile, where the source term (i.e., stockpile) is presumably thicker. The document must be revised to discuss the adequacy of the existing data for remedy selection.

The text must describe what is meant by *"above representative levels."* It is unclear if this is referring to background concentrations or some other criteria. See general comment #2.

FMC Response:

The RI Update Memo has been revised to reflect the historical use of RU 16. Please see the response to General Comment 2 and Specific Comment 66. Also see FMC's submittal to EPA dated September 7, 2004 and revisions found in Section 6.1.1, RU 16 of the December 2004 RI Update Memo.

68. Section 6.1.1, Page 6-8, RU 16

Provide a reference for the EMF RI table containing the analytical results for boring F160B. This information can not be located in existing files.

FMC Response:

Boring F160B was drilled to install a groundwater monitoring well. Bedrock was encountered at a depth of 107 feet, no groundwater was encountered in the boring, and the borehole was backfilled with cement grout. No soil samples were submitted for chemical analysis from this boring. A note has been added to the RU 16 map displaying boring F160B stating that no samples were collected and analyzed from this boring. Please see Appendix B of the EMF RI for the boring log.

69. Section 6.1.1, Page 6-8, RU 8, Last 2 Paragraphs in Section

The statement is made that the selected remedy of RU 16 *"could be effectively applied at RU 8."* It is unclear whether this indicates the intention to apply said remedy. The text must specify the remedial action anticipated for this site.

FMC Response:

As with all RU's, the remediation vision was stated in the accompanying summary figures. The December 2004 RI Update Memo includes a clear statement of the remediation vision for each RU in Section 6 text, as well as on the summary figures.

Specific to RU 8, FMC's remediation vision is to "Leave existing concrete slabs in-place, grade to design subgrade elevation and construct soil cover (cap) over entire footprint of these areas." This statement will be reiterated in the text discussing RU 8. Please see revised text in Section 6.1.1, RU 8.

70. Section 6.1.1, Pages 6-6 to 6-7, RU 22C, 1st Sentence in section

Based on this discussion, it appears that the liner required by the 1998 ROD has not been installed, and that the only liner present at this site was one installed over a portion of the swale in 1993. The lateral extent of the 1993 liner must be depicted on Figure 6-5. It is not possible to evaluate the results of the EMF RI soil borings without knowing where they were collected with respect to the existing liner. Additionally, the "Data Gaps" identified in Figure 6-4 states, *"Potential for P4 above the liner."* It is not possible to evaluate this statement about data gaps without the information regarding the locations of the existing liner and the previous EMF RI sample locations.

In addition, since FMC will no longer control use and access in the vicinity of the railroad swale, the remedy needs to be designed to ensure that the site does not pose a significant risk to future users of the site. Since the phos dock overflowed into this area, samples must be collected to determine the lateral and vertical extent of contamination and to characterize wastes present at the site. This information will be required to design a final cap that contains the waste and is protective.

70. Section 6.1.1, Pages 6-6 to 6-7, RU 22C, 1st Sentence in section

Based on this discussion, it appears that the liner required by the 1998 ROD has not been installed, and that the only liner present at this site was one installed over a portion of the swale in 1993. The lateral extent of the 1993 liner must be depicted on Figure 6-5. It is not possible to evaluate the results of the EMF RI soil borings without knowing where they were collected with respect to the existing liner. Additionally, the "Data Gaps" identified in Figure 6-4 states, "*Potential for P4 above the liner.*" It is not possible to evaluate this statement about data gaps without the information regarding the locations of the existing liner and the previous EMF RI sample locations.

In addition, since FMC will no longer control use and access in the vicinity of the railroad swale, the remedy needs to be designed to ensure that the site does not pose a significant risk to future users of the site. Since the phos dock overflowed into this area, samples must be collected to determine the lateral and vertical extent of contamination and to characterize wastes present at the site. This information will be required to design a final cap that contains the waste and is protective.

FMC Response:

The liner extent will be illustrated on Figure 6-5, along with the storm drain outfall location (i.e., location where P4 was potentially introduced into the RR Swale.) Please see revised text in Section 6.1.1, RU 22c and new Figure 6-5a.

Deleted: .

71. Section 6.1.1, Pages 6-7 to 6-8, RU 8, General Comment

Clarify in the text whether the kiln scrubber overflow pond and the ditch leading to it are considered part of RU 8 or RU 9. Figures 6-8 and 6-31 are confusing on this point. Based on process knowledge, the kiln scrubber overflow pond and ditch should be included in RU 8.

FMC Response:

Based on process knowledge and EMF RI data, it appears the kiln scrubber overflow pond and ditch were used for transporting/storing clarified kiln scrubber water. The kiln scrubber solids were deposited in the kiln scrubber ponds, so there is likely to be significantly less of an accumulation of kiln scrubber solids in RU 9. FMC's remediation vision for RU 8 is capping, while the remediation vision for RU 9 is no further action, pending the results of the SRI/SFS. Please see revised text in Section 6.1.1, RU 8 and Figure 6-8.

72. Section 6.1.1, Page 6-7, RU 8, Last Sentence in Section

Revise the text to discuss whether or not the silt aquifer overlying the uppermost aquifer has been shown to be laterally extensive, whether or not it is a horizontal aquitard or is sloped, and whether tests have been performed to determine the leakage factor.

In addition, since the precise location of the kiln scrubber ponds is not known, and because the levels of radionuclides and inorganics in the waste is not known, the RI Update Memo must be revised to indicate this is a data gap. To address this data gap samples should be collected to

81. Section 6.1.3, Page 6-16, 2nd Paragraph, & Page 6-19, Technical Area 6

Although geotechnical data from a proposed borrow area are found in Appendix D, these raw data cannot be evaluated for suitability as cover material until we are provided with a cover design.

FMC Response:

Comment noted. Appendix D was provided for information only, and is not considered final design criteria for any covers/caps that FMC may install. The cover page for Appendix D reflects this.

Deleted: However, we must point out that the data included in Appendix D was obtained specifically to demonstrate that the soil from the borrow area is suitable for use with the "capillary-barrier enhanced" RCRA cap (a.k.a. Pond 8S cap) that have been constructed at the property

82. Section 6.1.3, Page 6-17, Technical Area 1, 2nd Paragraph in Section, Last Sentence

The RI Update Memorandum must include more information regarding the types of materials that are being proposed for disposal at the area in between RU17 and 18. Information should include both the potential for contamination and the physical properties of the wastes in order to design an adequate cap. The waste zone must not have void spaces that could compromise the integrity of the final cover.

FMC Response:

FMC assumes that the comment refers to the type of materials being managed in the Recyclable Material Landfill (RU 17) and the Plant Landfill (RU 18). There are no waste disposal sites in the area "in between RU 17 and 18" as stated in the comment.

The materials managed in the Recyclable Material Landfill (RU 17) are described in Table 6-3 and in the description of SWMU 89 in Table A-17 in Appendix A of the RI Update Memo. FMC does not plan to add any additional materials to the Recyclable Material Landfill during facility decommissioning and demolition.

The materials managed in the Plant Landfill (RU 18) are described in Table 6-3 and in the description of SWMU 45 in Table A-18 in Appendix A of the RI Update Memo. The Plant Landfill will continue in use for management these types of nonhazardous wastes during facility decommissioning and demolition.

All the wastes managed in the landfills are nonhazardous and generated on-site. The landfill is managed to minimize void space and interim cover is applied periodically with a bulldozer or loader. These RCRA Subtitle D industrial landfills are not subject to permitting requirements. As noted in Section 6, FMC's remediation vision for RU 17 and RU 18 is to install a cover consistent with EPA's presumptive remedy guidelines for municipal landfills.

83. Section 6.1.3, Page 6-19, Technical Area 4, 3rd Paragraph in Section, Last Sentence

It is reasonable to assume that slag will become a component of the engineered covers. However, note that the covers over RU 18 and 19 must also minimize infiltration. The last sentence must be revised to read, "The final cover design will integrate the slag into the landfill cover and be designed to minimize infiltration through the waste."

FMC Response:

The RI Update Memo has been revised in accordance with the comment.

84. Section 6.1.4, Page 6-23, RU 20 – Former Bannock Paving Area

The source causing elevated nitrogen levels in monitoring well #139 must be identified.

FMC Response:

In the discussion of RU 20, FMC will add the following:

> "During the EMF RI, elevated levels of nitrate were detected in groundwater samples from Well 139, located approximately 450 feet west of the coke drying scrubber basin. The source of this nitrate was not confirmed during the EMF RI. Subsequently, a potential source has been identified. Wet coke was stockpiled in the area of Well 139 before the coke was dried and used in the elemental phosphorus production process. Coke production is a major source of ammonia sulfate, a fertilizer compound, and wet coke can contain a significant amount of ammonia because it has not been fully dried. The wet coke stockpile was not covered or lined, so precipitation could infiltrate the wet coke, oxidize and leach ammonia, and ultimately transport it to the uppermost aquifer. The Eh in the vadose zone would also allow mobilized ammonia to oxidize to nitrate as it was transported through the vadose zone."

The RI Update data gaps discussion for RU 20 now states that the residual coke characterization will include leachability testing for ammonia and nitrate to confirm the source of elevated nitrate in Well 139.

85. Section 6.1.4, 6-25, RU 5 – Lab and Old Drain Field

Additional VOC and semi-VOC samples must be collected to complete the characterization at this RU.

FMC Response:

The following text was improperly inserted in the discussion for RU 4. The RI Update Memo has been revised, and the following discussion will apply to RU 5:

> "Although the EMF RI did not identify the disposal area behind the lab as a potential source to groundwater, additional characterization is needed for VOCs and SVOCs in the shallow soils in order to reach a no further action decision or if the area should be evaluated in the SFS. If VOCs and/or SVOCs are detected, limited hotspot remediation will be evaluated in the SFS."

103. Section 6.1.4, Page 6-30, RU 15 & Figure 6-40

Based on the RU description presented in Figure 6-39, wastes at this site are heterogeneous consisting of mounds of reject ore, baghouse dusts from multiple sources, and pieces of carbon electrodes. No information is presented to indicate the type of wastes present in the immediate vicinity of boring F127B. A characterization of these wastes must be provided.

FMC Response:

The December 2004 RI Update Memo has been revised to note: "A characterization of the wastes around boring F127B was presented in the EMF RI Report, page 4.2-166. The boring encountered calciner pond sediments at a depth of 5 feet, and native soils below that interval. See also Table 4.2.3-33 of the EMF RI Report for the data from boring F127B."

104. Section 6.1.4, Page 6-30, RU 15 & Figure 6-40

A discussion regarding the depth of contaminant migration observed in Boring F127B, and whether it would be reasonable to expect this depth of migration throughout this RU, given the heterogeneous waste materials present must be provided. This information will be required for cap design.

FMC Response:

The RI Update Memo has been revised to reflect historical uses at RU 15, and to acknowledge the uncertainties associated with the data and potential for contaminant migration.

Deleted: to note: "As noted in the EMF RI (Section 4.2, page 4.2-166), only orthophosphate and potassium were detected at concentrations significantly exceeding background levels in samples from 15', 25', and 35' in boring F127B. Metals were near or below background levels in these samples.¶
A sample collected from a depth of 5 feet in the native soils showed concentrations of potassium, orthophosphate, total phosphorus, boron, thallium, and zinc that were above background levels (however, all were significantly below the updated RBCs).¶
Given the location of F127B, it is reasonable to expect similar depths of migration in other locations of RU 15 because the materials stored in RU 15 were dry (no free liquids), and data associated with ore and calciner solids indicate constituents of concern are not mobile. Coke dust was from coke that was received dry and handled within RU 7 before entering the furnaces, so the presence of soluble ammonia is not expected at RU 15.

105. Section 6.1.4, Page 6-30, RU 15

This RU discussion is confusing. The remediation vision presented in the fourth paragraph suggests that the RU poses an unacceptable risk. However, this does not appear to be supported by the data that are briefly mentioned in the sixth paragraph. Although there are insufficient samples to compare statistically to RBCs or background concentrations, the last paragraph concludes that there are no data gaps. It is unclear whether an unacceptable risk has been identified at this RU, or whether an unacceptable risk is simply presumed based on process knowledge of waste materials present. The text must be modified to clarify these issues.

FMC Response:

Based on data collected during the EMF RI, ore exceeds the Site Worker RBC for arsenic, and ore is the primary material stored within RU 15. Therefore, it was concluded that RU 15 poses an unacceptable risk to future site workers via direct exposure. The text has been revised to reflect this.

106. Section 6.1.4, Pages 6-31 & 6-32, RU 23, 1st Paragraph

The document must be revised to clarify which road segments are included in this RU. The text states that Figure 3-1 identifies the road segments in this RU, but roadway borings are shown both inside and outside of the RUs on this Figure. Additionally, the legend in the upper right corner of Figure 3-1 states that RU 23 road segments are "not shown." This is especially

116. Appendix A, Section A.2, Page A-2, Figure A-3: FMC Facility Summary (Actual figure located in sec. 4.2.3.1 EMF RI Report), Last Paragraph, Last Sentence

The limited data for organic contaminants collected during the original RI indicates contaminant migration from the waste zones under conditions without sustained hydraulic head. Additionally, some inorganic contaminants appear to have migrated out of the waste zone at some sites that do not have sustained hydraulic heads (e.g., RU 16). Discussion in other sections of this document needs to make it clear that the conclusions in the 1991 RI Report may not be supported by the existing data.

FMC Response:

Please see response to Specific Comment 113.

117. Appendix A, Section A.3, Page A-2, Table A-16, SWMU-17, Storage Area B

It appears that some of the borings described under the "EMF RI Findings" column were actually drilled in RU's 14 or 15 (i.e., F128B, F050B, and F127B). Please delete references to these two borings from the RU17 line item, and move to the appropriate RU descriptions.

FMC Response:

The appropriate revisions have been made in the December 2004 RI Update Memo.

118. Appendix A, Section A.3, Page A-2, Table A-16, SWMU-17, Storage Area B

The information presented in the "Current Status" column indicates that a soil cap was installed over this portion of RU 16 in 1993. This information must be discussed in the RU 16, Section 6 of RI Update, since it will be important for remedial design. Section 6 must be revised to describe the extent of the 1993 remediation effort, including cover materials, lateral extent, cover thickness.

FMC Response:

Agreed. Information regarding the partial cover is presented in Section 6 (see new Figure 6-10a).

119. Appendix A, Section A.3.1, Page A-4, 4th Bullet

The limited data for organic contaminants collected during the original RI suggests that at some sites there appears to be, or the potential exists for, contaminant migration from the waste zones under conditions without sustained hydraulic head. Currently, there may not be monitoring wells located appropriately to intercept potential releases from these sites. Please delete this bullet and modify the conceptual site model to depict this potential release mechanism.

FMC Response:

Please see the proposed document revisions submitted to EPA on September 7, 2004. SWMUs where materials containing free liquids may have been managed are identified in Appendix A.

APPENDIX H
REVISIONS
REDLINE/STRIKETHROUGH

Appendix H
XRF Screening for Phossy Solids

As documented in Appendix F of this report, analysis of available radionuclide-specific data for the various feedstocks and waste streams historically processed at the FMC Plant OU demonstrates that external exposure to gamma radiation drives risks to potential future workers for all source materials (except phossy solids) at the FMC Plant OU. With respect to phossy solids (including precipitator dust), incidental ingestion and fugitive dust inhalation of lead-210 and polonium-210, together with external exposure to gamma radiation, contribute virtually all of the risk to workers exposed to this source material. Therefore, analyzing samples for lead-210 and polonium-210, in conjunction with taking gamma dose rate measurements, is proposed to address radiological risks in areas that may contain phossy solids. The purpose of this appendix is to provide an outline of the approach that will be used identify the presence of phossy solids at gamma dose rate measurement sites during the SRI. The approach is outlined conceptually in this document, and is provided for information only. Complete documentation of this methodology will be submitted to the EPA for approval in the SRI Work Plan.

Phossy solids (including precipitator dust) are characterized by relatively high concentrations of arsenic, cadmium, lead, silver, and zinc when compared to the concentrations of these same metals in ore, ferrophos, and slag. These metals can be detected via field portable x-ray fluorescence (XRF) spectroscopy. Table H-1 presents the concentrations of metals in phosphate ore and ferrophos. Table H-2 presents the concentrations of metals in pond sediment (i.e., precipitator slurry) and Table H-3 presents the concentration of metals in slag. The ratios of the concentrations in precipitator dust and the concentrations in ore, slag and background are presented in Table H-4. These ratios were calculated by dividing the average concentrations in precipitator dust by the average concentrations in ore and slag. For the ratios between precipitator dust and background concentrations, the EMF RI background levels were used. As shown in Table H-4, the higher values indicate the relative enrichment of the metal in the precipitator dust when compared other materials that might be mixed with precipitator dust.

Column 5 of Table H-4 highlights, in bold text, metals with concentrations in pond sediments that are greater than approximately twenty times the concentrations found in slag. While the ratios of arsenic and silver concentrations are high, the actual concentrations are near the XRF detection levels for these metals. Arsenic and silver are therefore not considered good candidates as indicators for phossy solids. Table H4 does however indicate that cadmium, zinc and possibly lead may be used to indicate the presence of phossy solids.

H1 Conceptual Sampling Approach

Details of the sampling approach will be provided in the supplemental remedial investigation work plan. The conceptual framework for the proposed work includes collecting samples from a sub-set of the locations at which gamma dose rate measurements are taken during the SRI, and screening these samples for the presence of phossy solids in an on-site laboratory using a field portable x-ray fluorescence spectrometer. In addition, any location containing fill material that exhibits the visual characteristics of phossy solids will be sampled and screened. Consistent with the approach being taken to collect gamma dose rate measurements, XRF screening during the SRI will be restricted to RUs for which a remedial vision of capping is not currently envisioned

FRONT MATTER
SWAP PAGES

ACRONYMS/ABBREVIATIONS

AFM	Anderson Filter Media
AOC	(1) administrative order on consent; (2) area of concern
ARAR	applicable, relevant or appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
BAPCO	Bannock Paving Company
BCF	bioconcentration factor
BHHRA	Baseline Human Health Risk Assessment
C	Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
C.F.R.	Code of Federal Regulations
cm	centimeters
CO	Carbon Monoxide
COC	constituent of concern
COPC	constituent of potential concern
CSM	conceptual site model
d/yr	days per year
DO	dissolved oxygen
DQO	data quality objective
E&E	Ecology and Environment, Inc.
ED	exposure duration
EE	exposure estimate
EF	exposure frequency
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
FEDS	FMC Environmental Data System
FIP	Federal Implementation Plan
FS	feasibility study
ft	feet
FTIR	Fourier transform infra-red
g	gram
GAA	generator accumulation area
gm/cc	grams per cubic centimeter
HBL	Health Based Limit
HEAST	Health Effects Assessment Summary Tables
HHRA	human-health risk assessment

HQ	hazard quotient
ICR	Incremental Cancer Risk
IDEQ	Idaho Department of Environmental Quality
IOI	Idaho Optimization Initiative
IRIS	Integrated Risk Information System
IWW	Industrial Waste Water
kg	kilogram
kg/L	kilograms per liter
kph	kilometers per hour
km	kilometer
L/kg	liters per kilogram
LDR	land disposal restriction
LEC	level of ecological concern
LOAEL	lowest observed adverse effect level
$\mu g/m^3$	micrograms per cubic meter
m^3	cubic meter
MCL	maximum contaminant level
mg/cm^2	milligrams per square centimeter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MRL	minimum risk level
m/s	meters per second
NCEA	National Center for Environmental Assessment
ND	Not Detected
NFA	no further action
NOAEL	no observed adverse effects level
NORM	Naturally Occuring Radioactive Material
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NWS	National Weather Service
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
p	precipitation
PCB	polychlorinated biphenyl
PCDT	Pond Closure Decant Water
pCi	picoCuries

PEF	particulate emission factor
PIC	Pressurized Ion Chamber
PPRTV	peer-review toxicity values
PRG	preliminary remediation goal
QA	quality assurance
RA	remedial action
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RI	remedial investigation
RME	Reasonable Maximum Exposure
ROD	record of decision
ROPC	radionuclides of potential concern
RU	remediation unit
RU-1, RU-2, etc.	Remediation Unit 1, Remediation Unit 2, etc.
s	second
SEP	supplemental environmental project
SFS	supplemental feasibility study
SMWU	solid waste management unit
SOW	statement of work
SPM	Scoping and Planning Memorandum
SRI	supplemental remedial investigation
SSL	soil screening level
SUF	site use factor
TB	toxicity benchmark
TCLP	toxicity characteristics leaching procedure
TI	Toluene Insolubles
TIP	Technology Innovation Program
TPH	total petroleum hydrocarbons
TRV	toxicity reference value
95% UCL	95% upper confidence level
UF	uncertainty factor
UTS	Universal Treatment Standard
VKT	vehicle kilometers traveled
VOC	volatile organic compound

WMU	waste management units
XRF	X-Ray Fluorescence
yr	year

EXECUTIVE SUMMARY
SWAP PAGE

substantive changes in site conditions at the Old Phossy Ponds (RU 22b), and the Railroad Swale (RU 22c) since the EMF Site RI/FS was completed. The conclusion of the 1998 EMF Site ROD that remedial action is needed at these areas therefore continues to be supported.

Additional site characterization data are needed at the remaining RUs. However, these data needs are spatially focused and include:

- Delineating the lateral extent of a RCRA-engineered cap to prevent exposure to soils containing elemental phosphorus associated with historic spills and leaks from process equipment at the former elemental phosphorus production, storage, and handling areas in RU 1 and RU 2;
- Measuring gamma radiation levels where slag has been used as construction fill;
- Sampling several sites in RUs 4, 5, and 20 where fuel oils and solvents were managed to determine the need for potential "hotspot" removal; and
- Collecting additional soil samples at RUs 3, 4, 5, 6, 9, 11, and 13 to compare inorganic constituents with screening criteria at a greater statistical confidence level than can be supported with the existing data.

No further site characterization data are needed to evaluate potential risks to ecological receptors in the undeveloped western and southern portions of the FMC Plant OU. While there are minor excedences of target risk thresholds for several avian and plant species with respect to fluoride, there is only a marginal likelihood that an adverse effect on population size or community composition of species in the area will occur.

A supplemental remedial investigation to address the data needs identified in this Memorandum will be implemented and can be completed in a timeframe that supports future commercial/industrial redevelopment of the site.

SECTION 2
SWAP PAGES

- Infiltration/percolation of constituents from a) unlined waste management units that operated with a sustained hydraulic head; b) unlined waste management units at which wastes containing free liquids were managed; and c) petroleum storage facilities, could have impacted subsurface soils
- Deposition (fallout) of constituents from former emissions at the FMC and Simplot facilities;
- Process spills and leakage from former P4 production, storage, and handling areas;
- Storage of feedstocks, byproducts, or waste materials in unlined stockpiles;
- Use of feedstocks, byproducts, or waste materials as fill (including use of materials in roadbed); and
- Spills of solvent and/or petroleum hydrocarbons at limited areas of RU 5, 12, 20, and 22b.[5]

Air: Air quality may be impacted through the following release mechanisms:

- Generation of fugitive dusts by wind;
- Generation of fugitive dusts by vehicle traffic on unpaved roads containing feedstocks, byproducts, or waste materials;
- Generation of fugitive dusts from excavation of impacted soils;
- Oxidation of P4 during excavation soils containing over 1,000 mg/kg P4, resulting in a potential fire or evolution of smoke (P2O5);
- Radon emanation from feedstocks, byproducts, or waste materials containing radium-226;[6]
- Intrusion of organic vapors into buildings overlying the limited areas of RU 5, 12, 20 and 22b at which solvent wastes may be present[7]; and
- Air emissions from the adjacent J.R. Simplot Co. facility.

Groundwater: Groundwater quality may have been impacted through the following release mechanisms:

- Infiltration/percolation of constituents from unlined waste management units that operated with a sustained hydraulic head, and in the case of the J.R. Simplot Co. gypstack, continues to operate with a sustained hydraulic head. In addition, groundwater quality may have been impacted through the operation of unlined waste management units at which wastes containing free liquids were managed, and potential impacts may have occurred from petroleum storage facilities.

Surface Water and Sediment: There are no surface water bodies within the FMC Plant OU. However, the Portneuf River and Batiste Springs Channel are within the adjacent Off-Plant OU.

[5] The potential presence of solvent and petroleum hydrocarbon contamination is believed to be restricted to RU 5, 12, 20, and 22b as discussed in Section 6.
[6] The EMF ROD requires that future office buildings be constructed using radon control methods specified in an EPA guidance document titled "Radon Prevention in the Design and Construction of Schools and Other Large Buildings" (EPA 1994a)
[7] The potential presence of solvent and petroleum hydrocarbon contamination is restricted to RU 5, 12, 20, and 22b as discussed in Section 6.

for the FMC Plant OU will be used as a framework to develop the scope of a supplemental remedial investigation and feasibility study of remedial action alternatives for the FMC Plant OU.

EPA provided two sets of comments from the agency coordination committee on an October 2003 draft schematic of the updated CSM. These comments, which are reprinted in Table 2-4, concern the identification of potential sources, release mechanisms, exposure media, and exposure pathways. Table 2-4 outlines how these have been addressed in the updated CSM.

The updated CSM illustrates how contaminants from source areas may be transported to other media and identifies which media are of principal concern with respect to potential current and future receptors and exposure pathways. The updated CSM reflects a future commercial/industrial land use for the FMC Plant OU, with institutional land use controls in place that prevent residential uses of the site as well as preventing consumption of contaminated groundwater, as required by the EMF ROD for the FMC OU.

Figure 2-10 illustrates the updated CSM for potential human exposure within the FMC OU. Individuals potentially exposed to FMC OU-related contaminants include current and potential future site workers and nearby residents. The principal current and/or potential future exposure pathways are:

- Dermal contact with, and incidental ingestion of, contaminated soils, byproducts, and waste materials;
- External radiation exposure from contaminated soils, byproducts, and waste materials;
- Inhalation of fugitive dusts generated during excavation of contaminated soils, byproducts, and waste materials;
- Fire or smoke if P4 is exposed to air as a result of excavation of subsoils containing P4 at a concentration above 1,000 mg/kg;
- Incidental ingestion of P4 and inhalation of fugitive dusts assumed to contain phosphoric acid are potential exposure pathways for soils containing less than 1,000 mg/kg P4;
- Inhalation of radon, and exposure to radon-decay products, in indoor air;[12]
- Inhalation of organic vapors intruding into indoor air by indoor workers at limited portions[13] of RU 20; and
- Inhalation by off-site residents of fugitive dusts generated by wind and traffic on unpaved roads during site construction activities.

[12] The EMF ROD requires that require that future office buildings be constructed using radon control methods specified in an EPA guidance document titled "Radon Prevention in the Design and Construction of Schools and Other Large Buildings" (FMC 1994a)

[13] The potential presence of solvent and petroleum hydrocarbon contamination is believed to be restricted to RU 5, 12, 20, and 22b as discussed in Section 6.

current workers are similarly applicable to future workers associated with potential industrial reuse of all, or portions of, the FMC facility. The CSM also assumes that there will be no administrative controls in place that will reduce or control future site worker exposures.

The updated CSM identifies four types of future receptors: Commercial/Industrial Worker (subdivided into an Indoor Worker and an Outdoor Worker[17]); Utility Installation Worker; Construction Worker; and Off-site Resident.[18]

There is no current residential use of land within the FMC Plant OU and residential use of land within the FMC Plant OU would be inconsistent with industrial reuse. Moreover, FMC has filed land use restrictions with Power County that preclude residential uses of the FMC Plant OU, with the exception of the parcel formerly owned by the Union Pacific Railroad containing the closed Batiste Spring pumphouse. The FMC plant obtains its drinking water from wells within the deep aquifer, which currently meets MCLs. Future potential users of the FMC Plant OU would be required to obtain drinking water from wells within the deep aquifer or from the Pocatello municipal water supply system. Other potential uses of the groundwater beneath the FMC Plant OU, such as cooling water, process water, or possibly irrigation (likely restricted to the western undeveloped portion of the FMC Plant OU) will be evaluated in the SFS. Available data will be reviewed as part of the SRI to ensure the data will support this evaluation.

[17] A commercial/industrial worker may divide his/her time between indoor and outdoor activities.
[18] The Off-Site Resident might inhale fugitive dusts generated by traffic on unpaved roads during site construction activities and wind generated fugitive dusts for the remainder of the exposure duration.

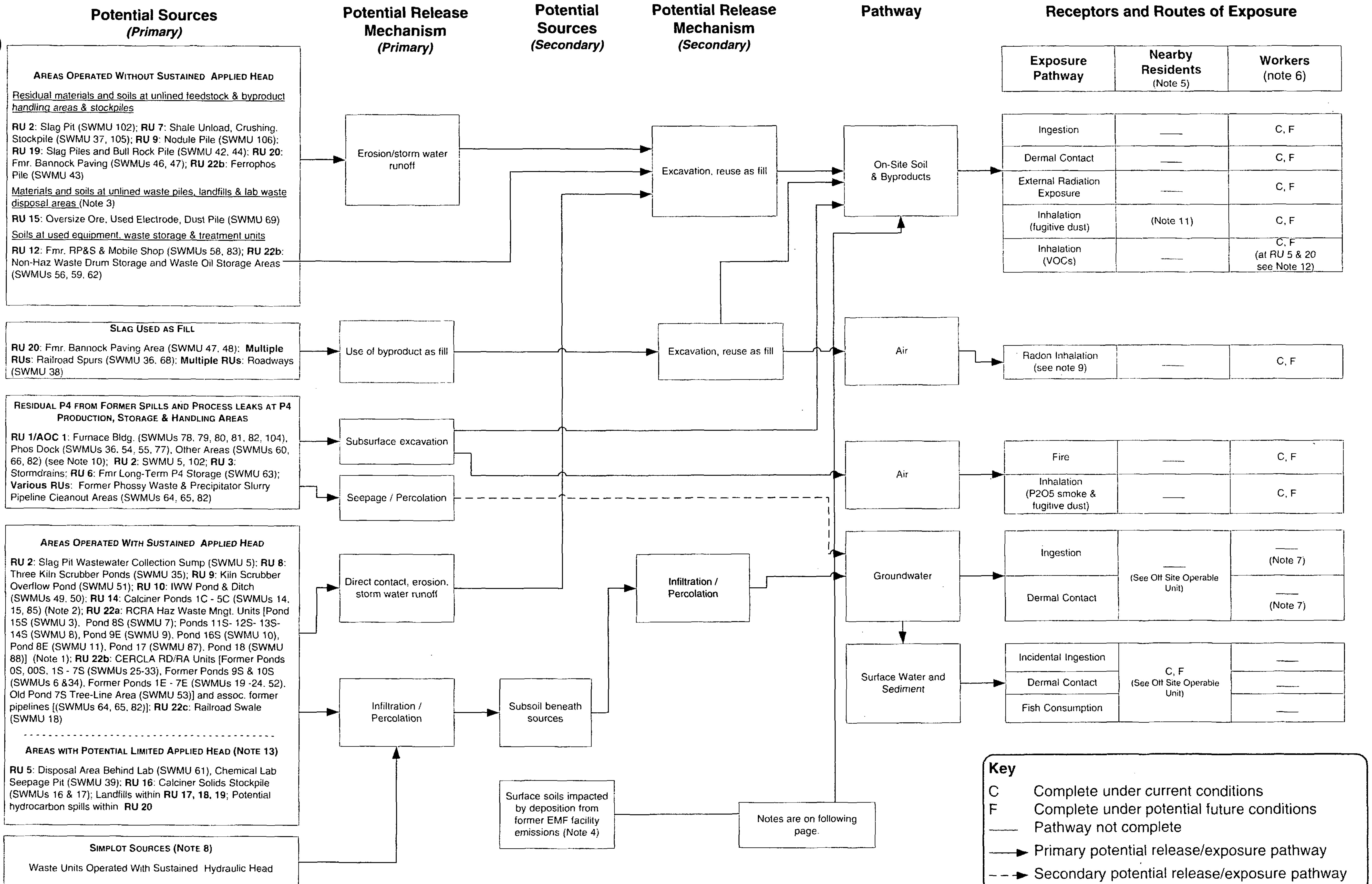


Figure 2-10: Conceptual Site Model for Potential Human Exposure to Contaminants at the FMC Operable Unit

December 2004

Note 1 - These waste management units are in the process of closure pursuant to RCRA standards.

Note 2 - Remediation of the Calciner Ponds 1C-5C and the underlying Old Calciner Ponds is being conducted under a Consent Order with the IDEQ.

Note 3 - Railcars within Slag Pile included in RU 19. Alledged buried transformers included within RU 12.

Note 4 - Includes potential deposition resulting from former emissions from the FMC and Simplot facilities.

Note 5 - Based on the ROD definition of off-site areas (i.e., properties not owned by FMC or Simplot).

Note 6 - Administrative controls protect current workers from exposure.

Note 7 - Exposure precluded through administrative controls and land use restrictions.

Note 8 - Potential sources at the Simplot facility are subject to the Simplot CERCLA RD/RA Consent Decree and applicable Clean Air Act standards. Evaluation of these sources, including development of remedial action objectives, is not within the scope of the supplemental RI/FS for the FMC OU.

Note 9 - Future office buildings are to be constructed using radon control methods, per EMF ROD.

Note 10 - RU1 SWMUs 13, 73, 74, and 76 did not manage P4-containing materials. These SWMUs have been "clean closed" and are not included.

Note 11 - Off-Site Resident might inhale fugitive dusts generated by vehicle traffic on unpaved roads during site construction activities.

Note 12 - The presence of "hotspots" of volatile organic compounds at limited portions of RU 4 (SWMU 61: Disposal Area Behind Laboratory), RU 5 (SWMU 39: Chem Lab Seepage Pit) and RU 20 (Former Bannock Paving Area) are subject to further evaluation.

Note 13 - These areas did not operate with a sustained hydraulic head in a manner similar to a pond. However, free liquids may have been present in the waste materials managed or disposed at the area. If present, these free liquids may have seeped into underlying soils and groundwater.

SECTION 3
SWAP PAGES
3-8 to 3-11

Geotechnical Data for Cap Design

Geotechnical data were obtained for soils and slag used in the construction of caps at RCRA WMUs in RU 22a. These materials are anticipated to be used in constructing caps at other RUs, and these data will be useful in designing the caps. These data are provided for information only and are not considered final design criteria. FMC understands that any design approvals required by the EPA will occur after preparation and review of the appropriate design documents during the SFS and RD/RA phase.

Bannock Paving Area Spill Investigation

In 1997, the Jack B. Parsons Company, operators of the former Bannock Paving Company Area (RU 20), conducted a site investigation to determine the nature and extent of contamination associated with a reported spill of approximately 1,000 gallons of oily sludge from a railcar. A former employee reported the spill occurred as BAPCO employees were preparing a railcar for use as a storage tank, and they dumped the oil sludge from the bottom of the railcar to the ground. As part of this investigation, eight test pits were dug in the spill area, and samples of native soils were collected from the base of these test pits. In one test pit, TP-6, there was visual evidence of petroleum hydrocarbons within the slag fill. A sample was collected from the depth interval of 2 to 3 feet below the surface, and one sample was collected from the native soils at a depth of 5.5 feet. Results are summarized in Table 3-4, and the sample locations are shown in Figure 3-1.

Coke Analyses

TCLP test data were obtained from analysis of samples of coke supplied by the FMC facility in Kemmerer, Wyoming.

FTIR Data at Ponds 16S, 17, and 18

Open-path Fourier Transform Infra-Red (FTIR) Spectrometers were installed at Ponds 16S (WMU #10; SWMU 10), Pond 17 (WMU #14; SWMU 87), and Pond 18 (WMU #15; SWMU 88) in 1999 to continuously monitor phosphine and hydrogen cyanide concentrations at the berms of each pond. The FTIR systems were installed pursuant to the RCRA Consent Decree. Quarterly summaries of the FTIR data were submitted to EPA Region 10 and the Shoshone-Bannock Tribes. The FTIR systems at Ponds 16S and 17 were removed during installation of the initial fill and temporary covers at each pond. The initial fill and temporary cover was installed at Cell A of Pond 18 in 2002. Cell B of Pond 18 will be closed by waste removal at a later date. The Pond 18 FTIR system, which encompassed Cell A and Cell B of Pond 18, was removed in January 2004 after EPA agreed that the system was no longer necessary.

While these FTIR data may be useful in characterizing phosphine and hydrogen cyanide emissions from operating ponds, they do not appear to be relevant to the current status of the ponds and have not been included in the FEDS database.

EPA Radionuclide Study of P4 Thermal Process and Other Studies

EPA collected 6 samples of phosphate ore, 6 samples of calcined briquettes, one sample of silica, one sample of coke, one sample of ferrophos, and 6 samples of slag in December 1976 from the FMC facility. These samples were split. One set was analyzed at EPA's EMSL laboratory and the other set was analyzed at EPA's EERF laboratory. Both laboratories analyzed these samples for radionuclides in the uranium-238 decay series and the thorium-232 decay series. Table 3-5 presents the analytical results reported by each laboratory (EPA 1977[1]). EPA noted that the EMSL results for lead-210 were found to be in error by up to a factor of 5 too low.

For the reader's convenience, Table 3-5 includes data on radionuclide activities in potential source materials obtained by FMC in the following studies described in Section 3: the EMF RI Report (Bechtel 1996), the Pre-Start Up LDR Radionuclide Study (Astaris 2001b); and an analysis of a sample of Calciner Pond 2-C wastewater. The radiological data presented in Table 3-5 are also referenced in Appendix F of the RI Update Memo.

LDR Treatment System Development Studies

FMC performed several analytical studies in support of developing a facility to treat phossy wastes to meet RCRA Land Disposal Restriction standards and the requirements of the FMC RCRA Consent Decree. Construction of the LDR Treatment System was terminated in the fall of 2001 before the system was placed into operation.

ZIMPRO Pilot Study

Pilot tests of the ZIMPRO treatment was conducted at the US Filter Company's facility in Wisconsin during the spring and summer of 1999. Phossy wastes collected from Tanks V-3600, V-3700, and V-3800 were combined at the US Filter facility in various ratios and processed using the ZIMPRO treatment system under a variety of test conditions. The pilot tests are described in Section 4.1.3 of the FMC's LDR Waste Treatment System Submittal (FMC 2000). Section 4.1.3 includes a tabulation of analytical data for samples of untreated and treated materials.

Toluene Insolubles Study

FMC used a toluene extraction procedure in its laboratory to assay the quality of the P4 product manufactured during facility operations. Toluene insoluble solids (TI) referred to the fraction of the P4 test sample that, unlike P4, is insoluble in toluene. TI solids were essentially non-P4 furnace off-gas dusts that had not been removed from the P4 process stream by the electrostatic precipitators.

Operation of the LDR Waste Treatment System was designed to limit the rate at which metals entered the treatment system to levels protective of human health and the environment. In lieu of developing metal feed rate limits, Astaris[2] proposed to monitor the amount of P4 and TI in the slurry tanks feeding the main treatment step of the LDR Treatment System (the caustic hydrolysis reactor).

The relationship between TI and P4 and metals was examined in *Characterization and Variability Analysis of Toluene Insolubles and Selected Metals in LDR Reactor Feed Slurry* (Astaris 2000b). The phossy waste streams from the Phos Dock and precipitator slurries were sampled and analyzed over a five-month period. The 93 samples were analyzed for TI solids, P4 and eighteen metals. It was established that TI and P4 could be used as a surrogate for measuring the amounts of the individual metals that were to be fed and treated in the LDR

[1] EPA 1977: Radiological Surveys of Idaho Phosphate Ore Processing -- The Thermal Process Plant. Office of Radiation Programs, Las Vegas Facility, Las Vegas, NV. Technical Note ORP/LV-77-3

[2] Astaris Idaho LLC, a joint venture formed by FMC and Solutia, operated the Pocatello facility from April 2000 until early 2002.

process without endangering human health or the environment. Results showed that the TI and P4 could be used for this purpose for sixteen of the metals, while the remaining two metals, Co and Hg, were generally found to be present at concentrations below the detection limits of the analytical methods used in this study. The combined waste feed stream were to be further sampled during start up of the LDR Treatment System to confirm that TI and P4 can act as a surrogate for measuring the amounts of the individual metals for all eighteen metals.

The study and related statistical analyses determined that:

1) The correlation between TI and metals' concentrations was strong for Al, Sb, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, Tl, V, and Zn.
2) The relationship between TI and arsenic was found to depend on both TI and P4 concentration in the waste feed slurries.
3) Analyses for cobalt and mercury found, that for more than half of the samples, the concentration of these metals was below the detection limit of the analytical methods used. About one-fourth of the selenium and thallium samples also analyzed below the detection limit.
4) For As, Ba, Be, Cu, Mn, and Ni the concentration of metal at a given %TI was found to be higher in the Clarifier Underflow (CU) wastes from the Phos Dock than in the Precipitator Slurry (PS) wastes.
5) Combinations of the CU and PS wastes in the expected LDR feed ratio showed that for Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, V, and Zn all the combinations contained substantially less metal than the assumed concentration that was used in the Direct Inhalation Risk Assessment.
6) Combinations of the CU and PS wastes in the expected LDR feed ratio showed that for Co, Hg, and Tl some of the combinations contained higher concentrations of metal than the assumed concentration that was used in the Direct Inhalation Risk Assessment."

Pre-Start Up LDR Radionuclide Study

Samples of Tank V-3600, V-3700, and V-3800 discharges were composited in the proportion expected in the feed to the reactor system at the LDR Waste Treatment System (then under construction). The composite samples were analyzed for radionuclides in the uranium-238 decay series, as well as gross alpha and gross beta. The methods used in the study and the analytical results obtained are presented in Astaris 2000. The analytical data are included in Table 3-5.

Calciner Solids Study

During 1999 and 2000, FMC collected samples from Calciner Ponds 1C, 2C, 3C, 4C, and 5C and analyzed them for selected metals using the TCLP methodology. FMC also performed total metals and TCLP analyses on samples co-located to those collected by IDEQ in 2001. The results of these analyses are presented in Tables 3-2 through 3-4 of the Remedial Design Work Plan for the Calciner Ponds (FMC 2002).

Pond Closure Decant Treatment System

FMC developed a wastewater treatment system to treat water decanted from a series of phossy waste ponds during their closure and to support decommissioning of the plant. This system is referred to as the PCDT system. It is designed and operated to treat wastewaters to meet the Universal Treatment Standards (UTS) identified in the RCRA Land Disposal Restrictions standards prior to the use of the treated water for dust suppression on interior roads during 2004 and 2005.

FMC provided information in support of this on-site water treatment and the use of treated water for dust control in a November 21, 2003 letter to EPA and as supplemented by a memo to EPA dated December 5, 2003 and a letter to EPA dated December 30, 2003. This letter and supplemental information, which is reproduced in Appendix I, provides:

- An estimate of the residual levels of treated water constituents in soil at those areas where water is applied, including naturally-occurring radioactive materials;
- A description of the treatment process and management of water for dust control;
- The results of bench testing to treat Pond 17 decant water to meet UTS levels;
- An evaluation of NORM constituents prepared in support of FMC's original proposal to discharge treated water to the Pocatello POTW;
- Clarification of dust control water application compared to evaporation rates by month; and
- A map showing the construction and general areas for dust control during 2004 and 2005.

As indicated in Appendix I, the application of PCDT-treated water to roads for dust control meets applicable or relevant and appropriate requirements, does not significantly add incrementally to metals or NORM already present in soils at the site, and conserves clean water that would otherwise need to be withdrawn from the aquifer.

SECTION 4
SWAP PAGES

4.6.3 Summary of Off-Site Residential SSLs

Table 4-19 presents the COPC-specific, off-site residential fugitive dust inhalation SSLs for carcinogenic and non-carcinogenic endpoints. In the case of COPCs that exhibit both carcinogenic and non-carcinogenic effects, the health endpoint resulting in the lowest SSL was conservatively used to characterize the screening level for that constituent.

For P4, the toxicity-based SSL was found to be greater than the level at which this constituent may spontaneously oxidize (smoke). However, there is no potential for off-site residents to be directly exposed to P4-containing soils on the FMC Plant OU. Consequently, the concentration at which spontaneous oxidation may occur (1,000 mg/kg) is not relevant to this receptor.

By comparing the off-site residential SSLs (Table 4-18) to those developed for a construction worker (Table 4-16), it is evident that the construction worker SSLs are consistently more conservative (i.e., lower) than the off-site residential SSLs. Therefore, use of the construction worker SSLs for screening RUs in which redevelopment could potentially occur within the SRI/FS will be protective of off-site residential receptors.

4.7 Summary

Table 4-20 summarizes the chemical-specific SSLs calculated in this section for outdoor and indoor commercial/industrial workers, construction workers, utility workers and off-site residents. These SSLs were derived using the default methods contained within current EPA guidance (EPA, 2002). Additionally, in the absence of site-specific data, EPA's default values were used to characterize each of the parameters within the SSL equations. EPA (2002) states that "These equations and the default input values are designed to reflect reasonable maximum exposure (RME) for chronic exposures in a commercial or industrial setting". Moreover, EPA (2002) indicates that while the default values were not selected to represent worst case conditions, they are conservative. Thus, uncertainty within SSLs derived using EPA's default methods and assumptions errs on the side of worker protection. When available, and in accordance with the guidance, site-specific data were used to characterize input parameters (e.g., meteorological factors). The use of site-specific data, in place of the default input values, inherently lowers the degree of uncertainty within the derived SSLs. Finally, in the absence of both site-specific data and default values, professional judgement, supported by EPA SSL case study assumptions, was used to characterize several input parameters describing the specific details of a future site redevelopment scenario at the FMC Plant OU. While these latter input values are likely associated with the greatest degree of uncertainty, it should be noted that EPA does not identify any of the parameters characterized using professional judgement as being sensitive with respect to the model results. Moreover, the selected values are considered conservative with respect to characterizing any future redevelopment of the FMC Plant OU. Thus, each of the SSLs derived in this section are considered to be conservative (i.e., err on side of worker protection), and can be applied as risk-based screening levels in the evaluation of the need for additional sampling and/or remedial action within select FMC Plant OU RUs throughout the SRI/FS process.

As shown by comparing the chemical-specific SSLs for each receptor, the construction worker SSLs are consistently lower (i.e., more conservative) than the screening levels for each of the other receptors. Thus, for RUs on the FMC Plant OU in which construction redevelopment could potentially occur, use of the construction worker SSLs to screen COPCs within the SRI/FS would be protective of all other potential receptors associated with foreseeable future activities in these RUs.

Similarly, the chemical-specific outdoor commercial/industrial worker SSLs are consistently lower than the corresponding screening levels for indoor commercial/industrial workers and utility workers. Thus, for FMC RUs in which commercial/industrial redevelopment could occur (without the potential for building construction), use of the outdoor commercial/industrial worker SSLs to screen COPCs within the SRI/FS would be protective of all other potential receptors associated with foreseeable activities in these RUs.

Finally, the utility worker SSLs are applicable to screening FMC Plant OU RUs in which commercial/industrial redevelopment and construction activities are not envisioned.

SECTION 6
SWAP PAGES

Section 6
Application of DQO Process to Remediation Units

This section presents a comparison of the expanded set of available site characterization data with the RBCs presented in Section 4 (along with the RBC developed for P4) as a screen to identify areas potentially requiring additional characterization.

This section also includes a comparison of site characterization data with representative levels of constituents in soils. The term "representative levels" was used during the EMF RI to acknowledge that soils in the EMF Study Area have been affected by anthropogenic activities not related to the EMF facilities, and that background concentrations in the study area should not be considered pristine, unaffected background levels. Representative levels were determined by EPA's risk assessment contractor, E&E, during the EMF RI. The derivation of these levels was documented in the Baseline Human Health Risk Assessment for the EMF Site (E&E, 1997). For the purposes of the following discussion, representative levels and background levels have the same meaning and are used interchangeably.

Constituents of Concern (COCs) and Constituents of Potential Concern (COPCs) within each RU are identified in Table 6-1. COCs are constituents confirmed to be present in a RU based on sampling results and/or process knowledge. The presence or absence of COPCs within specific RUs has not been confirmed. For RUs with a remediation vision that includes a cap/cover, investigation of COPCs is not identified as a data gap because the envisioned remedial action will meet RAOs for the COPCs as well as COCs present within these RUs. For RUs with a remediation vision of no further action anticipated to be necessary, the SRI scope will include sampling for COPCs. Details of each investigation will be provided in the SRI Work Plan.

EPA selected remedies for the Calciner Solids Storage Area (RU 16), the Old Phossy Ponds (RU 22b), and the Railroad Swale (RU 22c) in the 1998 ROD. EPA subsequently elected to reconsider the 1998 ROD; consequently, implementation of these remedies was stayed pending EPA's further review.[1] FMC believes that these areas continue to warrant remedial action. As a result, these areas were evaluated to determine if there have been any significant changes since the EMF remedial investigation that would bring into question the appropriateness of the remedies selected in the 1998 ROD, and if so, whether additional characterization is appropriate prior to reevaluating these areas for remedial action during the SFS process.

EPA's Data Quality Objectives (DQO) process (EPA 2000) was used to evaluate each RU. At some of the RUs, FMC anticipates implementing a presumptive remedy of containment, and the DQO procedure was reformatted to follow EPA's Technical Areas for Presumptive Remedies of

CERCLA Municipal Landfills (EPA 1995) for landfill-like units or similar wastes. At RU 16 and RU 22b, FMC anticipates implementing the remedy selected for that area in the 1998 ROD.

FMC also anticipates implementing the 1998 ROD remedy selected for groundwater. Groundwater impacts, flow patterns, flow rates, source areas, and fate and transport were characterized during the EMF RI. Subsequent monitoring has supported the conclusions drawn in the EMF RI (Sections 3.3, 4.4 and 5). FMC will continue the voluntary CERCLA

[1] Further review of potential remedial action technologies is available in Treatment Technologies for Historical Ponds Containing Elemental Phosphorus – Summary and Evaluation (EPA 2003). This document is also referred to as the EPA TIP Report.

groundwater monitoring and the RCRA groundwater monitoring at the FMC Plant OU throughout the SRI/SFS process. The EMF RI findings, coupled with ongoing groundwater monitoring and additional source characterization during the SRI, as described below, will provide sufficient information to support the RD/RA.

The remainder of this section focuses on characterizing soil and solid media in the exposure pathways and at the 0-10' depths that may be encountered during future site redevelopment and industrial/commercial use. Where there are uncertainties regarding the nature of impact of potential sources on groundwater quality, and the remediation vision does not include a cap/cover over the RU, the need to further evaluate the potential source is noted as a data gap to be addressed during the SRI. Where a cap/cover is identified as the remediation vision, the cap/cover design will incorporate measures to reduce/minimize infiltration through the materials. The DQO process will be used to develop the appropriate methods for defining and characterizing potential sources to groundwater.

The DQO process has seven steps. They are:

1. State the problem.
2. Identify the decision
3. Identify the inputs to the decision
4. Define the study area
5. Develop decision rules
6. Specify the allowable error on the decisions
7. If needed, optimize the sampling program

The primary purpose for following the DQO process was to develop an objective and data-supported decision regarding classification of each RU for the SRI/SFS. Figure 6-1 summarizes the DQO process as applied to the various RUs. A detailed discussion is provided in the following text of this section.

Step 1, State the Problem: The FMC Plant OU has been the subject of CERCLA and RCRA environmental investigations, and these investigations have identified constituents of concern that were released into the environment through various plant processes and material handling practices. The problem is that areas within the FMC Plant OU have been used for waste disposal, some areas are former working areas with the potential for P4 occurrence in the subsurface, and other areas have had multiple uses through the operational history of the plant. Characterization data may or may not be sufficient for evaluating the future exposure scenarios, or for conducting the SFS. A structured approach is needed to evaluate the available information, and support the decision (see Step 2).

Step 2, Identify the Decision: The decision that must be made is to classify RUs within one of the following categories:

1. No Further Action – RU does not contain materials or environmental media that exceed RBCs for the relevant exposure pathways, or
2. RU contains materials or environmental media with constituent concentration(s) that exceed RBCs, and no additional data are needed to support an evaluation of remedial action alternatives under the SFS process, or

3. Collect additional data to: (a) evaluate classification of No Further Action or (b) support the SFS analyses of remedial action alternatives.

Step 3, Inputs to the Decision: There are numerous inputs to the decision for each RU. The generic inputs for each RU are discussed below.

The 1998 EMF Site ROD detailed a decision for institutional controls, monitoring and a contingent extraction for hydraulic control to prevent exposure by human and ecological receptors to contaminated groundwater at the FMC Plant OU. In addition, the ROD selected deed restrictions to prevent future residential use at the FMC Plant OU, and it specified that new buildings shall be designed and built to prevent indoor radon exposure. The remedies selected in the ROD were protective of human health and the environment assuming continued plant operations, and in many respects also would be protective during plant shutdown (such as the ROD's requirement for institutional controls for future land use scenarios with respect to the old phossy ponds, calciner solids area, the Railroad Swale and groundwater).

RUs 17, 18, and 19 are landfills, or have landfills within their boundaries. In their comments on the draft Scoping and Planning Memorandum for the SRI/SFS, reviewing agencies recommended that FMC consider application of the Presumptive Remedy for CERCLA Municipal Landfill Sites (Directive 9355.0-49FS, EPA 1993) for these landfills. Other RUs within the FMC Plant OU that were identified for capping include the old phossy ponds (RU 22b), Railroad Swale (RU 22c), and the calciner solids storage area (RU 16). These areas were evaluated to determine if changes in site conditions require additional data collection prior to conducting the SFS or Remedial Design.

Other inputs to the decision include the Updated RBCs presented in Section 4 of this report, changes in operations since the 1998 ROD, and evaluation of spills/releases of process materials that occurred from 1994 (the end of the EMF remedial investigation field sampling period) to the present. Appendix A provides a detailed description of changes to the SWMUs that have occurred since the EMF RI.

Table 6-1 summarizes the Constituents of Concern (COCs) and Constituents of Potential Concern (COPCs) for each RU within the FMC Plant OU.

COCs are constituents known or considered likely to be present in fill and waste materials within the RU boundaries. For example, because cadmium was detected at levels above RBCs in soils within RU 13 during the EMF RI, cadmium is considered a COC within RU 13. Process knowledge was also used to determine the presence of COCs within several RUs. RU 8 is an example where knowledge of the kiln process (used before calciners were installed) indicates that residual sediments from the former kiln scrubber ponds within RU 8 contain materials with COCs similar to those contained in calciner solids.

A constituent is identified as a COPC where there is suspicion that a release containing that constituent may have occurred, or where there are insufficient data and process knowledge to rule out a past spill or release containing that constituent. For example, in RU 20, BAPCO used several above-ground fuel oil and diesel storage tanks. While there were no documented releases from these tanks, FMC considers fuel hydrocarbons a COPC at RU 20 recognizing that these most likely are within the CERCLA petroleum exclusion. Thus, a decision of no further action at RU 20 cannot be supported with the available data. Similarly, at RU 4 and 5, there were minor levels of VOCs detected in soil samples. These VOCs are associated with the Chem Lab Seepage Pit. As with fuel hydrocarbons in RU 20, FMC recognizes that VOC's at RU 4 and RU

5 must be adequately characterized to support a decision to either remediate hotspots or to take no further action.

The application of Pond Closure Decant Treatment (PCDT) water to FMC road segments for dust suppression is another input to the decision, and was evaluated in the discussion of RU 23. The discussion also applies to road segments within the boundaries of other RUs; however, discussing the PCDT water application on road segments within each RU would be redundant.

Step 4, Define the Study Boundaries: In this step, the lateral boundaries for each RU were selected based on knowledge of past activities and materials handled within the RU. In many cases, the RU can be easily defined laterally because it is bounded by roads, structures, or other features. A limited number of activities occurred within these spatial boundaries and known materials were associated with these activities. Vertically, the study boundaries are from existing grade to a depth of 10 feet (see updated Conceptual Site Model in Section 2). These vertical boundaries were selected because they encompass the exposure pathways for the various future commercial/industrial land use exposure scenarios identified in the updated CSM.

RU 14 is being remediated under the purview of the IDEQ, and RCRA Waste Management Units within RU 22a are being closed under EPA Region 10's RCRA standards. These RUs are not within the study boundaries, and will not be considered in the SRI/SFS.

Deeper soils have not been included in the study boundaries at this time because there is no evidence of an active source (i.e., source with sustained hydraulic head) of contamination to groundwater, and because exposure to these soils is not anticipated under future commercial/industrial exposure scenarios. The exception is that deeper soils beneath RU 1 and RU 2 (possibly RU 3 and RU 4), cannot be excluded because there is a potential for P4 migration into these deeper soils.

In addition, groundwater was not included in the study boundaries because the 1998 EMF ROD selected land use restrictions on the future use of groundwater at the FMC Plant OU.

However, each RU was evaluated to ensure that sources that could impact groundwater were identified and that the existing groundwater monitoring network would be sufficient to demonstrate achievement of the following 1998 ROD RAOs:

1. Prevent potential ingestion of ground water containing COCs having concentrations exceeding RBCs or MCLs (chemical-specific ARARs).
2. Restore ground water that has been impacted by site sources to meet RBCs or MCLs for the COCs

Step 5, Develop the Decision Rules: In this step, the decision rules for this DQO Process are stated:

1. Was the RU a former pond that is not part of a RCRA WMU or Calciner Pond subject to remediation under the IDEQ Consent Order and either, (i) used for disposal/storage of phossy waste, or (ii) used for storage of calciner solids? If yes, document any significant changes in site conditions since the 1998 ROD, and determine if the RU can be forwarded to the SFS (characterization and remedial action defined under 1998 ROD, Section 10.2.2.1). If no, go to the next question.
2. Was the RU a former working area with production, storage, or handling of P4 that created a significant potential for spills and/or leaks? If yes, evaluate the RU under the

technical areas for former P4 working areas and determine if additional data are needed under the SRI, or if the existing data are sufficient, the RU can be forwarded to the SFS. If no, got to the next question.

3. Was the RU a landfill, or is a landfill present within the RU boundaries? If yes, consider the RU for application of the presumptive remedy for CERCLA Municipal Landfills and evaluate the available data against the RI/FS Technical Areas for application of the presumptive remedy to decide if additional data are needed during the SRI or if the RU can be forwarded to the SFS. If no, continue to the next question.
4. For the remaining RUs, are there sufficient data to statistically compare the constituents of concern with RBCs or other relevant screening criteria? If yes, decide whether the RU can be classified as "No Further Action – RBCs are not exceeded in environmental media" or "RBCs are exceeded, RU is not eligible for NFA and the RU should proceed to the SFS." If no, forward the RU to the SRI process for additional sampling and/or analyses.

It should be noted that for all RUs, the following conditions must be met in order to forward the RU to the SFS:

- Data must be sufficient to meet the RI/FS technical areas for former P4 working areas and landfills, as applicable (in some cases, the technical areas can be addressed during the SFS, and these are described in more detail). Technical areas for landfills are those defined in the EPA's guidance on the presumptive for CERCLA landfills (EPA, 1993), whereas the technical areas for former P4 working areas are those described later in this section.
- At the former pond areas, available information must support the conclusion that site changes since 1998 are not significant, and do not require additional characterization data.
- In other areas, the statistical comparison between site data and RBCs must show that sufficient data are available to support the decisions for all COPCs.

Step 6, Specify the Allowable Error on the Decisions:

Decision 1 Error: The decision to classify an area as an old phossy pond or calciner solids storage area has a very low associated error. The boundaries of the old ponds and calciner solids storage areas are well-documented from historic aerial photos and from the current site conditions. For example, calciner solids storage areas can be readily delineated through visual inspection of disturbed ground vs. adjacent areas that are undisturbed. The old phossy ponds can be accurately delineated from aerial photos that show their location, size, and period of usage. Furthermore, classification of an area as a former phossy pond will cause the area to be forwarded to the SFS for implementation of the remedy selected in the 1998 ROD (capping or placement of the appropriate cover).

Decision 2 Error: Determining whether the RU was part of a former P4 working area has a very low error associated with the decision. Given the detailed information regarding past practices, and that the P4 processing and storage facilities were permanent structures, this "yes" or "no" question can be answered with a high degree of confidence. Furthermore, the evaluation of the RI/FS technical areas associated with the P4 former working areas decreases the error associated with this decision, because that evaluation requires an extensive review of past practices, spills, fluid collection points, and potential leakage points (e.g., concrete-lined sumps, surface spill collection points, etc.) from which P4 could enter the subsurface.

Decision 3 Error: There is low error associated with the decision, because each RU that was a landfill will be forwarded to the SFS for application of the presumptive remedy of containment. If data are lacking to adequately address some or all of the RI/FS Technical Areas outlined in EPA's RI/FS guidance for data collection at landfill sites, these data gaps will be addressed as part of the SRI. The "yes" or "no" answer is straightforward, and can be verified through a review of aerial photos and a review of plant practices through the years. The review of the RI/FS Technical Areas from EPA guidance on presumptive remedies for landfills will serve to reduce the associated error, because that review will be based on the factors specified in that guidance.

Decision 4 Error: A Type I error (alpha) rate of 5% was selected, and a Type II (beta) rate of 10% was selected. For comparisons with RBCs, the delta value is defined as the difference between the 95% UCL of the mean of RU-specific data and the RBC value(s). When comparing site characterization data with representative or background levels, delta is the difference between the 95% UCL of the mean and the background value for a given constituent. Section 6.1.4 provides a detailed description of delta values. Variance and associated standard deviation values were estimated from RU-specific data where sufficient numbers of samples were available. EPA DQO Guidance allows for a Type I confidence level of 80% to 95%, and FMC has selected the conservative 95% confidence level for RUs that may be subject to redevelopment and future occupancy by other industries or commercial ventures (EPA, 2000a). The higher degree of confidence associated with the Type I error offers a higher degree of certainty that future site workers will not be inadvertently exposed to media above RBCs.

In cases where there were insufficient samples, a data gap was identified. These data gaps will be addressed as part of the SRI Work Plan.

Step 7, Optimize the Sampling Program: This step will be implemented in the SRI Work Plan, and is not part of the RI Update. However, the outcome of Steps 1 through 6 will be carried forward to the SRI Work Plan to ensure the SRI Work Plan meets the appropriate objectives. A preliminary scope of sampling and analyses (modeling) for the SRI is summarized in Section 7.0 of this RI Update.

6.1 Results of Step 5 – Classification of Remediation Units

The following discussion presents the results of Step 5, and is summarized in Table 6-2.

6.1.1 Former Ponds or Calciner Solids Storage Area

RU 22b (CERCLA RD/RA Units or "Old Phossy Ponds"), RU 22c (Railroad Swale), and RU 16 (Calciner Solids Stockpile) are areas identified for remedial action in the 1998 ROD. The ROD selected a capillary cap design or soil cover for these RUs, and noted that treatment technologies were neither cost-effective nor technologically feasible, thereby supporting the decision for capping. EPA's subsequent evaluation of potential treatment technologies for historical ponds containing elemental phosphorus (EPA 2003) is supportive of the remedy selected in the 1998 ROD for the old phossy ponds.

The former kiln scrubber ponds, located beneath Calciner #2 within RU 8, are included in this grouping for the following reasons:

1. The kiln scrubber ponds contain material similar to the calciner ponds. The similarity of material is due to the similarity between the kiln and calcining processes.
2. The 1998 ROD selected capping or covering the calciner solids, and the kiln scrubber solids contained in the former kiln scrubber ponds are of a similar nature.

Prior to concluding whether these RUs can be forwarded to the SFS, site conditions must be evaluated to ensure that no significant changes have occurred since the EMF RI that would contraindicate the remedial action selected in the 1998 ROD for these sources. Significant changes can be activities that released significantly different types of COPCs, and activities that might have significantly altered the chemical or physical characteristics of the materials or their mobility.

RU 22b – Old Ponds:

The following discussion is summarized in Figure 6-2. Since the issuance of the EMF ROD in 1998, the old phossy ponds (Figure 6-3) at FMC have not received additional process materials. This has been confirmed by FMC plant personnel who have worked at the site from 1994 through the present.

EPA's Technology Innovation Program (TIP) published a report in 2003 documenting the treatment technologies available for elemental phosphorus sludges contained in the old ponds (EPA, 2003). In this report, EPA concluded: "....no new treatment technologies have emerged as potentially applicable to treat the historical ponds since the FS report." The TIP document includes a reference to the FMC CERCLA Feasibility Study (FMC, 1997a). EPA cited the following factors in its 2003 study:

- Treatment would likely require pre-treatment, exhaustive characterization of the material, and a significant engineering effort to design the treatment system(s).
- Worker exposure to the materials during remediation would involve significant worker-health protection measures.
- No waste treatment performance data are available. Few phosphorus-bearing materials have been successfully treated, either in-situ or ex-situ. Capping has been the selected alternative at most sites with similar pond materials. In-situ treatment was selected at only one facility, and that involved a significantly smaller volume of material.
- Costs incurred with treatment would be significantly greater than costs associated with the capping alternative.

As stated in the 1998 ROD:

> "Due to the presence of buried elemental phosphorus in some areas, the higher level of permanence afforded by the capillary barrier cap is warranted and the additional cost is justified. A soil cover and vegetation may be sufficient in areas which were used for a relatively short period of time and/or contain significantly lower volume of waste."

EPA noted in the 1998 ROD that the selection of the type of cap would be made during the RD phase for each pond or pond area based on the information available at the time of the RD.

The nature and extent of site-related impacts associated with the old ponds were characterized in the EMF Remedial Investigation Report (Bechtel, 1996). As noted in the RI Report, the old ponds were delineated through a review of historic air photos and site inspection. In the air photos, the location and boundaries of the old ponds can be readily seen and mapped in detail. Soil borings and samples were collected at the old ponds to confirm the presence of process materials and develop a conceptual model of the fate and transport of contaminants in the old ponds. Source material samples were collected and analyzed to characterize the materials placed in the ponds. A more detailed summary of the EMF RI findings can be found in Appendix A.

A cap infiltration analysis was performed as a follow-on activity to the Feasibility Study (FMC, 1997b). This infiltration study provided EPA with the necessary information to support cap designs for the various old pond areas. The old ponds at FMC were characterized in the EMF RI Report, Appendix M, and the history of the old ponds was used as the basis for proposing a cap design (Bechtel, 1996). FMC based the cap design on the amounts of residual materials remaining in the old ponds. If residual materials were excavated, capping to control surface water run-on/run-off and limit worker exposure would meet the RAOs. In old ponds where residual materials remained in place, infiltration reduction was an additional cap design objective.

A data gap associated with the lateral extent of buried phossy solids was identified during the review of available data, which could affect the area within RU 22b to be capped. Borings F058B and F059B, located in RU 13, encountered phossy solids at depths of approximately 5 to 7 feet below current grade. These boring locations are shown in Figure 3-1. During the SRI, the lateral extent of these phossy solids will be delineated to determine the final extent of capping within RU 22b. It is anticipated that step-out borings and/or trenching will be needed to identify the lateral extent of this waste layer. The extent will be mapped and used as supporting data for the SFS.

RU 22c – Railroad Swale

The discussion that follows is summarized in Figure 6-4.

The 1998 ROD states:

> "FMC shall install and maintain a synthetic liner in the eastern portion of the Railroad Swale to reduce infiltration of surface water and leaching potential. FMC shall modify and extend the existing liner at least 850 feet to the east. The liner shall have, at a minimum, a 30-mil PVC liner and be covered by a protective sand layer with a minimum thickness of 6 inches. Design and construction shall conform with work conducted on the existing liner in the western portion of the Railroad Swale and shall include sampling during design for potential generation of gases which could affect liner performance. FMC shall maintain the integrity and effectiveness of the liner and final cover, including making repairs to the cover as necessary to correct the effects of settling, subsidence, erosion, or other events."

The purpose of the Railroad Swale liner under the 1998 ROD was to prevent surface exposure of the materials in that unit and water infiltration into those materials. A number of post-RI surface spills of phossy water at the Phos Dock area drained to the Railroad Swale; Appendix A describes spill volumes, sources, and character of the liquids. Residues from these spills may be present in sediments above the partial liner installed in the Railroad Swale in 1993 or within the unlined portion of the swale downgradient from the liner (Figure 6-5).

The spills that occurred from 1994 through 2002 were relatively small volumes of phossy water from the furnace building and Phos Dock area. These spills were likely contained within the low-lying areas of the Railroad Swale. Due to these spills, FMC has identified capping as the remedial action vision for the Railroad Swale.

A cap that extends over the area originally proposed for lining should cover the areas affected by past spills. As with the old ponds, historic air photos were used to delineate the extent of ponded water in the Railroad Swale; extending the cap beyond the known ponding areas to the eastern edge of the FMC property should ensure that past spills of process materials will be contained.

Capping the Railroad Swale will minimize the potential of exposure to any constituents that may have collected in the swale, and will also reduce migration potential of these constituents. Surface water run-on/run-off management at the Railroad Swale will be a design issue and require analysis as part of the RD. However, additional data are needed to support the design of a cap.

Data Gaps

During the SRI, FMC will collect confirmation soil samples along the exterior boundaries of the railroad swale to delineate the extent of P4 and other COCs that may have been released. These data will be used to confirm the area to be capped.

RU 8 – Former Kiln Scrubber Ponds and Calciners

Figure 6-6 summarizes the discussion that follows. The boundaries for RU 8 were defined by the footprint of the former calciner facilities. FMC's remediation vision for RU 8 is installing a cap with the appropriate institutional controls to prevent exposure to any remaining kiln scrubber solids. Other objectives of the cap design will include minimization of infiltration through the old pond area and run-on/run-off management. The former ponds within RU 8 (Figure 6-7) were targeted for investigation during the RI. However, these ponds were inaccessible because the calciners were built over the pond footprint. In 2004, the calciners were physically removed as part of plant dismantling.

A 1965 aerial photo, which illustrates the former kiln scrubber ponds when they were in operation, was georeferenced and the pond outlines were drawn to show actual location and extent of the three ponds. This information will be used during the SFS to develop the cap/cover design for RU 8. The calciner foundations do not extend over the entire footprint of the former kiln scrubber ponds.

The RI identified the former kiln scrubber overflow pond as a potential source of contaminants to groundwater (Figure 6-8). The kiln scrubber overflow pond was operated as an overflow pond that received clarified water from the primary settling ponds. A portion of the ditch that conveyed water from the former kiln scrubber ponds to the former kiln scrubber overflow pond is within the boundaries of RU 8, and the remaining section of the ditch is within the boundary of RU 9. As with the kiln scrubber overflow pond, this ditch transported clarified water. Thus, there was low potential for significant accumulation of solids in this ditch or the overflow pond. For a further discussion of data gaps associated with these features, see the discussion of RU 9 in Section 6.1.4 of this document. All the kiln scrubber ponds were taken out of service in the late 1960's when the calciners were built. There is soil/slag backfill with a concrete slab covering the pond sediments left in place. The concrete slab over the former kiln scrubber ponds serves two purposes: reducing infiltration of water through any remaining pond solids, and preventing exposure to pond solids. However, some downward migration of metals may have occurred during operation of the calciners because there is a potential for leaks in the subsurface piping and sumps. These facilities no longer contain water associated with the calciner scrubber system, and are no longer potential sources of infiltration.

Although there is no indication the kiln ponds contain or stored P4, there is evidence from the RI that the ponds were a source of heavy metals to groundwater. Boring F054B, drilled in the area of the former kiln scrubber overflow pond, showed that site-related constituents had migrated from the base of the pond to the silt aquitard overlying the uppermost aquifer. Specifically, cadmium, zinc, and arsenic were found at above-representative levels in soil samples collected from the silt aquitard overlying the uppermost aquifer. The silt aquitard beneath RU 8 and RU 9 was characterized as part of the overall hydrogeologic investigation of the EMF RI (see sections 3.1, 3.3, 4.4, 5, and Appendix K of the EMF RI, BEI, 1996). In the area of RU 8 and 9, the aquitard is generally flat-lying, with a vertical permeability of approximately 10^{-6} cm/s.

Since 1994, there have been no changes at the former kiln scrubber ponds. Calciner #2 remained in service from 1994 until plant shutdown in 2001, with no process changes that would have impacted the underlying former kiln scrubber pond residuals.

The 1998 ROD did not select a remedy for these ponds. However, the ROD selected a capping/cover remedy for the similar calciner solids stockpile and the ponds in the western area of the FMC Plant OU.

Given the similarities between kiln solids and calciner solids, the remedy selected in the 1998 ROD for the calciner solids stockpile (see RU 16, below), likely could be effectively applied at RU 8.

Data Gaps

The only data gap is confirmation of the lateral extent of kiln scrubber pond sediments. The SRI scope will include up to six shallow borings or trenches along the exterior boundary of RU 8 to ensure the area proposed for a cap/cover encompasses the lateral extent of residual kiln scrubber solids.

RU 16 – Calciner Solids Stockpile:

The following discussion is summarized in Figure 6-9. The remediation vision for RU 16 is to implement the remedy selected in the 1998 ROD. The remedy selected was grading and installing a soil cover to prevent exposure to the calciner solids. The grading plan would include provisions for managing storm water run-on and runoff to reduce infiltration through the waste mass.

The EMF Remedial Investigation Report (Bechtel, 1996) identified two calciner solids storage areas – Storage Area A (associated borings F023B, F050B and F128B) and Storage Area B (associated borings F051B and F127B). FMC believes that the location of boring F127B is mis-plotted on RI Report Figure 2.1-1 and was located northwest of boring F051B and within the footprint of Storage Area B. This conclusion is based on the lithologic description of the surficial material in Boring F127B that show approximately 5 feet of calciner solids present. The plotted location is located on the reject ore pile within RU 15, indicating that F127B was not drilled in that location. A detailed description of SWMU 17 (Storage Area B) and SWMU 1 (the calciner solids stockpile, aka Stockpile Area A) can be found in the EMF RI Report (pages 4.2-161 through 4.2-165).

After completion of the 1996 Remedial Investigation, FMC constructed a new double-lined calciner solids solar drying pond (designated Calciner Pond 5C) at the location of Storage Area A. During construction of Calciner Pond 5C, any calciner solids and visibly contaminated soil within the planned footprint of the new pond (including solids and soils at the locations of borings F023B, F050B and F128B) were removed down to native soil (a depth of approximately 15 feet). The majority of these solids and soil were moved to the location of Storage Area B (in RU 16). Based on visual inspections at RU 15, it appears that a minor portion these materials were placed within RU 15 as well. Following placement of the removed solids and soil at Storage Area B, FMC placed about 1 foot of soil cover over the Storage B area (Figure 6-10a). Thus, Storage Area A - as described in the RI Report - no longer exists. The calciner pond solids and contaminated soil from Storage Area A are now beneath and within the area that is being addressed by the Calciner Pond Remedial Action Plan (under the Consent Order between FMC and IDEQ for remedial action at the calciner ponds).

The northern boundary of RU 15 is a common boundary with the southern boundary of the Calciner Pond Remedial Action area. As described above, a minor amount of materials from Storage Area A remain within RU 15, but a majority of these materials were placed in Storage Area B, within RU 16.

After Calciner Pond 5C became operational, the excess solids from this pond were removed and placed in the southern "half" of RU16, also referred as SWMU 16 (Figure 6-10).

The northern "half" of RU 16 consists of calciner solids originally dredged from the old calciner ponds and then excavated as part of the removal of Storage Area A during construction of Calciner Pond 5C. The southern "half" of RU16 consists of dried calciner pond solids periodically removed from Calciner Pond 5C during plant operation from 1995 through 2001. RU 16 only received calciner solids and some soil mixed with the solids removed from former Storage Area A and the soil cover placed over Storage Area B.

Since 1996, there were no changes to the calcining process. For example, construction and operation of the excess CO combustor in 2001 did not materially affect the calcining process. Thus, the materials placed on the stockpile after 1996 essentially were the same as those placed before that date.

Although the volume and areal extent (footprint) of calciner solids within RU 16 has increased since the 1998 ROD, the materials themselves have remained consistent in terms of their chemical and physical characteristics. Figure 6-10a illustrates the current extent of the calciner solids and also shows the area where soil has been placed over a portion of the calciner solids stockpile.Soil data from F051B and F127B do not support a definitive conclusion on the vertical extent of contamination beneath Storage Area B (SWMU 17). There are no soil borings in the southern portion of RU 16 to characterize the vertical extent of contamination.

Data from F051B indicate migration of contaminants to depths in excess of 14 feet (deepest sampled interval). Whereas F127B indicated that metals did not migrate deeper than 5 to 10 feet into native soils (EMF RI Report , Table 4.2.3-33 and page 4.2-164).

Data Gaps

Although the 1998 ROD indicated that the primary objective of the calciner solids stockpile cap/cover was to prevent exposure to these materials, there remains some uncertainty regarding the mobility of metals in the calciner solids. The SRI will address this uncertainty by collecting additional source characterization data to support the type of cap/cover selected for RU 16. For example, if the SRI data indicate that metals in the calciner solids have a very low leachability potential, a soil cover may be sufficient. On the other hand, if testing of the calciner solids indicates metals are leachable to the extent that groundwater quality may be impacted above relevant MCLs and RBCs, a cap that further reduces infiltration may be appropriate.

Leachability testing on randomly selected composited grab samples should characterize the leaching potential of the material. Materials in SWMU 17 and SWMU 16 will be characterized separately because SWMU 17 received a mixture of calciner solids and soils, whereas SWMU 16 received only calciner solids from Pond 5C.

Characterization of the vertical extent of contamination within RU 16 is also a data gap. Evaluation of available groundwater data will be performed prior to issuing the SRI Work Plan. Results of this evaluation will be included in the Work Plan to help justify whether or not additional soil borings are needed.

6.1.2 Former P4 Working Areas

Key points for considering remedial alternatives at the former P4 working areas are the delineation of P4 in the subsurface, mobility of P4, and the existing cover over P4 areas. The delineation of P4 poses unique challenges due the physical and chemical properties of P4. Specifically, P4 is a liquid at temperatures above 44 C and freezes (i.e., becomes solid) below that temperature and is essentially immobile in the subsurface. The P4 was maintained in a liquid during the majority of the manufacturing and handling processes at the plant. P4 was handled at temperatures typically in the range of 60 to 66 C while being transferred (i.e., displaced with water or pumped) between product vessels/tanks and for railcar loading. In the event of a P4 release, it would be released as a liquid, and migrate in the subsurface until it encountered soils with ambient temperatures less than 44 C. Once ambient soil temperatures fall below 44 C, P4 freezes and remains immobile as a solid. Soils beneath the slag pit and furnace building were heated to temperatures above 44 C from the intense heat source of continuous tapping of molten slag into the slag pit, until slag ladling was fully installed in 2000.

FMC has documented P4 releases from certain specific areas and suspects that other historic releases of P4 have occurred in the former P4 working areas. However, determining the exact release points from all the P4 process vessels, waste management units, and related piping would pose significant technical challenges such as drilling through reinforced concrete foundations, and would likely require a very dense grid of sample points. Even if all release points were confirmed and the local extent of P4 could be precisely delineated, the design of a treatment alternative for P4-containing soils would pose technical challenges similar to the potential treatment processes for pond sludges discussed in the EPA's TIP report (EPA, 2003).

An important consideration relating to the former P4 working areas is that FMC has already removed the majority of P4 in the process equipment, and is committed to the removal of all remaining P4 from process equipment, including P4 in subgrade sumps and other vessels. This P4 is being recovered for sale or off-site disposal (if it does not meet the quality standards for sale). When P4 removal from process equipment is complete, there will be no remaining primary sources of P4. The only sources of P4 will be secondary source(s) from past releases to the subsurface.

Subgrade piping in the former P4 working areas has been emptied, and will be plugged and abandoned in place within the boundaries of RU 1 and RU 2. FMC will evaluate the feasibility of removing the subgrade piping in areas between the former P4 working areas and the old ponds in RU 22a and RU 22b. The underground P4 process piping outside of RU 1 and RU 2 is the only potential P4 source outside RU 1 and RU 2 (there are no process vessels outside these RUs). Any potential P4 releases from this piping would be immobile because the ambient soil temperatures along the pipeline route are below 44 C. Given this immobility, excavation and removal of any P4-containing soils and backfill associated with the piping should be feasible.

In the former P4 working areas, there are multiple potential P4 sources that may have impacted subsoils, including spills over the 50+ years of plant operations, leaks from process and waste management vessels, and leaks from in-ground unlined launders and underground piping. Soil temperatures in parts of the RU 1 and RU 2 area were likely above 44 C, creating the conditions that could facilitate P4 migration from the release point. This conceptual model of P4 migration implies that the delineation of P4 distribution at depth would be very difficult if not impossible. FMC believes that the overall extent of potential P4 migration was constrained by the extent of the >44 C subsurface isotherm, and that the maximum historic extent of this isotherm can be calculated during the SRI to support development of a perimeter for a RCRA-engineered cap that will cover areas where P4 is presumptively present in the subsurface.

For RUs classified as former P4 working areas, the following RI/FS technical areas, modeled after EPA's technical areas for CERCLA Municipal Landfills, were developed to determine if sufficient data exist to support the decision outlined in Step 5 of the DQO Process.

RI/FS technical areas for former P4 working areas:

1. Worker Hazards – Excavation of former P4 working areas is evaluated with regard to the hazards associated with excavation of building foundations and reclamation of the former P4 working areas.
2. P4 in subsurface delineation – Data and information to determine the extent of P4 in the subsurface include process knowledge (where P4-containing liquids were stored, collected, or processed), location of sumps, underground pipes, and other vessels that may have leaked, and documentation of spills and their ultimate fate (collection sumps, storm drains, etc.).
3. Migration potential assessment – P4 is a liquid at temperatures greater than 44 C. At lower temperatures, P4 is a solid. A release of P4 at temperatures above the melting point into soils with ambient temperatures above 44 C could allow P4 to migrate to greater depths than a release where the ground temperatures are lower than the melting point. Sustained subsoil temperatures in excess of 44 C arising from 50 years of discharge of molten slag in the Slag Pit (RU 2) could contribute to further subsurface migration of the P4.
4. Existing cover assessment – At several buildings, the existing cover is the concrete slab foundation of the building. In other areas there is no existing cover at this time, and for the subsurface pipes, the existing cover is the backfill used in the trenches. In the former P4 working areas, it is likely that the backfill for buried pipes is similar to the fill logged

in numerous soil borings drilled in the main plant area, slag mixed with a small proportion of native soils.

5. Surface water run-on/run-off management – Each RU and capped area will require evaluation within the context of site-wide drainage and grading patterns. In addition, the former P4 working areas have existing surface water catchments and storm drains that allow for surface runoff to drain from the former working areas. Prior to remediation, these storm drains will be evaluated for plugging/abandonment to control infiltration through leaking storm drains into P4-containing soils, and to reduce the runoff through the former P4 working areas.
6. Cap design/source material characterization – FMC assumes that former P4 working areas such as RU 1 and RU 2 will be capped to reduce exposure potential and infiltration through the soils potentially containing P4. Therefore, FMC will confirm the cap design with EPA, and confirm the suitability of the cap materials for the reduction of infiltration.

6.1.2.1 RU 1 – Furnace Building and RU 2 – Slag Pit

Figure 6-11 summarizes the following discussion. The Furnace Building, Phos Dock, and Secondary Condenser area (RU 1) and Slag Pit (RU 2) are considered together because of their proximity and because of the documented occurrence of P4 in the subsurface within the RU boundaries (Figure 6-12). In addition, these Former P4 Working Areas are former heat sources that likely affected the mobility of P4 in the subsurface.

Worker Hazards

Although not directly applicable to the former P4 working areas, the TIP Report (EPA, 2003) documents the worker hazards associated with delineation, excavation, handling and treatment of P4 containing materials. The P4 released from spills and leaks within RU 1 and RU 2 is intermixed with soils and materials beneath the building foundations. Treatment of these soils to remove P4 would pose similar technical challenges associated with treatment of P4-containing sludges at the old ponds. These hurdles include:

- Controlling worker exposure to P4 during excavation and treatment
- Design of the appropriate treatment system
- Operation of the treatment system with variable inputs (varying concentrations of P4, varying soil types, etc.)

The TIP report concluded that there are no applicable treatment technologies available for P4-containing soils and sludges containing P4, metals, and radionuclides. This is relevant to the former P4 working areas within the FMC Plant OU, although the metal and radionuclide content of the impacted soils would be less that that found in old phossy pond sludge. The main hurdle for treatment of P4-containing soil and sludges was designing the appropriate treatment system that could accommodate the highly variable P4 content of the material.

Another factor that poses significant challenges to removal and treatment of P4-containing materials at RU 1 and 2 is the identification of areas where P4 is present. Unlike the phossy ponds where P4 is present in the sludges at varying concentrations, the P4 beneath RU 1 and RU 2 is likely to be scattered in "pockets" beneath these former working areas. In other words, the P4 content in soils beneath RU 1 and RU 2 is likely to be more variable than in pond sludges. Identifying the location of each "pocket" and characterizing the extent of these spills/releases would require a significant sampling effort, and the results would be inconclusive with respect to precluding all future exposure to P4. Extensive sampling of P4-impacted soils also increases the potential for worker exposure to P4 and other site hazards.

P4 in Subsurface Delineation

The following discussion focuses on the known and potential extent of P4 in the subsurface at the furnace building and slag pit. As described above, there are numerous concrete-lined P4 sumps, phossy water sumps, and other vessels that are potential P4 sources within RU 1. Past spills of process materials also can be considered potential P4 sources to subsurface soil and fill in the RU 1 area. Within RU 1 and RU 2, the slag and furnaces heated the underlying soils, providing conditions where P4 would have remained in a liquid state.

A leak in the #3 furnace P4 sump was discovered during the conversion to slag ladling in 1999-2000. During the conversion, P4 was encountered beneath the furnace building foundation. Upon investigation, small cracks were discovered in the concrete-lined sump, indicating this was a source of elemental phosphorus in liquid phase to the subsurface. Given the long service life of other concrete-lined sumps in the furnace building, the logical conclusion is that some of these process units are also potential sources of P4 within RU 1.

During the EMF RI, two soils borings were drilled in the paved area north of the furnace building (F064B and F069B). These borings did not encounter P4 at depths of 4.5 and 5.0 feet. Boring F052B, drilled in the secondary condenser area did not encounter P4. The total depth of this boring was 20 feet.

The CSM identifies potential exposure to soils and fill to depths of 10 feet. Only one soil boring within RU 1 and RU 2 extends beyond this depth, and there are no soil borings along the western and southern boundaries of RU 1 and 2 to confirm the extent of P4 in the 0-10 foot depth interval. There is insufficient data available to satisfy this technical area.

P4 Migration Potential Assessment

As noted above, when ambient temperatures exceed 44 C, elemental phosphorus is in a mobile, liquid state. In this state, it can seep through soil until it reaches areas with lower temperatures, at which time it solidifies and is no longer mobile as a liquid phase.

The density of P4 in a liquid state is 1.7 gm/cc. A P4 release from process equipment (all above the melting point) will migrate in a vertical, but tortuous path through the soil column. As long as there is a source of P4, and ambient temperatures remain above the melting point of P4, the P4 will continue migrating vertically to the water table. When the P4 encounters the groundwater, it will cool to below the melting point, and immobilize. As shown in Figure 6-13, the groundwater temperature at Well 108 exceeded 28 C, suggesting that groundwater with ambient temperatures of > 44 C could underlie the furnace building and slag pit (the most intense heat source). Once the ambient temperatures fall below the P4 melting point, only soluble concentrations of P4 would be transported by the groundwater. The solubility of P4 in water is 3 mg/l, and if the water has an oxidizing Eh, the P4 will be converted to an oxidized phosphorus compound (orthophosphate). The maximum concentration of P4 observed in Well 108 was 0.258 mg/l, well below the solubility limit of P4.

The 44 C isotherm in the soil column beneath RU 1 and RU 2 has not been mapped or modeled. This technical area is not satisfied, and additional evaluation is needed.

Existing Cover Assessment

At the Slag Pit, RU 2, there is no existing cover apart from the RCRA interim cover at the Slag Pit Sump, so an assessment cannot be performed. The Slag Pit Sump will be closed in accordance with the RCRA Closure Plan for this unit.

The furnace building foundation is primarily a level concrete slab with below grade sumps and launders. After demolition of the superstructure is completed, the sumps and below grade features will be backfilled and the fill material will be graded to manage run-on/run-off and prevent water accumulation in these areas. Below grade piping will be plugged and abandoned in place. If capping is selected as the remedy, the concrete foundation will be integrated into the final contouring of RU 1 and RU 2 during the RD phase. Cap design will be RCRA-equivalent, and will not rely on the concrete slab to minimize infiltration.. As part of the site decommissioning activity, all piping routed from the sumps will be emptied, plugged, and abandoned, and the sumps will be backfilled. Details of the foundation after all equipment and structures have been removed will be documented for the final cap/cover design.

Additional information to support a final cap/cover design is not required at this time. The integration of reinforced concrete slabs and paved areas into a final cover will be an engineering task during the SFS and RD.

Surface Water Run-on/Run-off Management

Management of surface water run-on/run-off within RU 1 and RU 2 will be a design consideration for capping these areas. The design can be performed during the SFS or RD phase, and the final cover configuration will be integrated into a master site drainage plan.

Cap Design/Source Material Characterization

As with the RCRA WMUs that have been capped or are undergoing closure, the borrow areas for soil covers are within the FMC Plant OU. These borrow areas have been characterized to confirm the material's suitability for cap material. Characterization includes permeability testing and sieve analyses to determine the grain size distribution and the clay and silt fraction of the material.

The permeability testing confirms the soils are suitable for reducing infiltration into the underlying waste-bearing material, thus reducing the potential for transport of contaminants to groundwater. The physical characterization data are presented in Appendix D.

As with the surface water management technical area, the final cap design would be performed during the SFS or RD phase, and the final cap design would be approved by EPA.

Statistical Comparison of Site Data with RBCs

The soil data collected within RU 1 and RU 2 were compiled and sorted to statistically compare with the 1998 RBCs, the Updated Site Worker RBCs, the Construction Worker RBCs, the Utility Worker RBCs and EMF RI background levels.

Only inorganic constituents were statistically analyzed.

Because there were no soil samples collected from 0' to 2', no comparison was made with the 1998 RBCs and the Updated Site Worker RBCs.

Constituent concentrations in soils within the 0' to 10' interval did not exceed the Construction Worker RBCs or the Utility Worker RBCs at the 95% confidence level.

Comparisons with the updated RBCs for P4 could not be performed because P4 analytical data were not available.

Site soil concentrations exceeded the EMF background levels for several constituents (Appendix C).

Data Gaps

A model to evaluate the extent of the 44 C isotherm should be performed to evaluate the areas where P4 may have migrated in a liquid state from potential sources in RU 1 and RU 2. The isotherm modeling study will be coupled with confirmation sampling to determine the extent of the area to be capped.

The confirmation sampling will be performed along the periphery of the modeled 44 C isotherm to confirm the modeling results and support decisions regarding the extent of the capped areas in RUs 1 and 2.

RU 6 – Long-term Phos Storage Facilities

The discussion of RU 6 is summarized in Figure 6-14. The long-term phosphorus storage area was built for P4 storage (Figure 6-15). This allowed FMC to own/lease and operate their railcar fleet with more flexibility.

In the early 1990's FMC determined that the long-term storage tanks were no longer economical. The P4 was removed from the tanks and the tanks were removed from the excavation. Tank removal occurred in two phases; eight were removed in 1994 and four removed in 1998. During both phases of tank removal, FMC personnel noted the presence of P4 in the tank backfill. The presence of P4 was around the fill holes, indicating the P4 in the backfill was due to overfilling rather than a P4 product leak.

Worker Hazards

Based on conditions observed during tank removal, low levels of P4 are anticipated in the subsurface. P4-related worker hazards are not anticipated to be significant at this RU.

P4 in Subsurface Delineation

As noted above, P4 was observed in the tank backfill at low levels. It has not been delineated within RU 6. Additional confirmation sampling is needed at RU 6.

P4 Migration Potential Assessment

P4 spills at RU 6 would be limited to the area immediately surrounding the former underground storage tanks and the railcar loading/unloading area. This is because spilled P4 would be cooled to below 44 C, and freeze if it had been released. As noted above, P4 was encountered in the tank backfill area. When the tanks were in operation, the P4 migration potential was very low, and after tank removal, there is no remaining P4 and therefore, no potential for P4 migration.

Existing Cover Assessment

There is no existing cover at RU 6. However, the removal of the P4 tanks and placement of clean backfill should not require the assessment of existing cover.

Surface Water Run-on/Run-off Management

Because the storage tanks and residual P4 in the tank backfill were removed during tank closure, surface water run-on/run-off management at RU 6 does not require a management plan.

Cap Design/Source Material Characterization

Because the P4 tanks have been removed, and P4-containing soils and backfill were removed, there is no need for a cap at RU 6. Therefore, cover source material characterization is not required.

Statistical Comparison of Site Data with RBCs

The soils sampled from the two borings within RU 6 did not exceed the RBCs for the analyzed COPCs (P4 was not analyzed). However, there is only one sample from the 0-2' interval and three samples from the 0-10' interval. These intervals are insufficiently characterized to reject the null hypothesis and accept the alternate hypothesis that concentrations of inorganics are less than RBCs.

The comparison against EMF RI background levels shows that several constituents exceed background levels and several are below the background levels. However, for many constituents, there are insufficient samples collected to support the decision at the 95% confidence level.

Data Gaps

There is a data gap in the 0-10' depth interval for inorganics. Additional samples are needed to perform the statistical tests at the prescribed confidence levels.

There is a potential that spills may have occurred during loading and unloading of railcars with P4. Shallow soil samples near the spur line are needed to evaluate the potential for P4 in the 0-10' depth interval.

Slag was not logged in the two EMF RI soil borings. However, slag was likely used as backfill in the old tank pit and as fill for the rail spur within RU 6. Gamma radiation measurements are needed to address the gamma radiations associated with slag backfill.

6.1.3 Landfills (RU 17, RU 18, and RU 19)

The discussion of landfills within the FMC Plant OU is summarized in Figure 6-16. The following discussion for landfills within the FMC Plant OU discusses all landfills together instead of each RU separately. Because of the similarities of the landfills, separate discussions would be redundant.

Three Remediation Units are known to contain solid waste landfills, RU 17, RU 18, and RU 19, at the FMC Plant OU (Figure 6-17). Given the known contents of the landfills, the agencies recommended that FMC consider application of the EPA's Presumptive Remedy for CERCLA Municipal Landfills. FMC's remedial vision for the three landfills includes capping or soil cover that effectively contains the wastes in these landfills. Key points that support the application of the presumptive remedy are:

- The 1998 ROD did not select a remedy for the operating landfills or the slag pile
- At RU 17 and 18, there is sufficient information to satisfy the EPA's six Technical Areas for RI/FS Data Collection for the presumptive remedy
- All three landfills fail EPA criteria for hotspot removal and treatment
- For RU 19, per the SPM, FMC will discuss potential infiltration/percolation of elemental phosphorus to groundwater and resulting impacts to groundwater quality from the 17 buried railcars (Figures 6-18, 6-19, 6-20, and 6-21). This will require

developing bounding assumptions for a source term and reasonably conservative hydraulic/transport properties to assess the possible impacts to groundwater. The potential source analysis of the sludge-filled railcars will be performed as part of the SRI.

- The landfills within RU 19 and RU 18 might have been disposal areas for solvents and waste oil. Past disposal practices may have allowed some of these materials to be placed in these landfills as a free liquid.
- The CSM recognizes that the former plant landfill, the railcars buried in the slag pile, and the existing plant landfill may be sources of contaminants to groundwater. Given this potential, an objective of the presumptive remedy will be to minimize infiltration through the waste mass in these RUs.

As noted above, the agencies recommended that FMC consider applying the presumptive remedy for the landfills within the FMC Plant OU. At RU 19, the presumptive remedy of containment will be applied to the former plant landfill and other areas of the Slag Pile known to contain process wastes, specifically phosphorus sludge buried in rail cars.

Each of these remediation units are considered in terms of the six Technical Areas defined in EPA's publication "Presumptive Remedies: CERCLA Landfill Caps RI/FS Data Collection Guide" (EPA, 1993). These six Technical Areas are:

1. Waste Area Delineation
2. Slope Stability and Settlement
3. Gas Generation/Migration
4. Existing Cover Assessment
5. Surface Water Run-on/Run-off Management
6. Clay Sources

Technical Area 3, Gas Generation/Migration, is primarily concerned with the migration of methane gases generated during the decomposition of organic materials within the landfill to structures and VOCs that may have been disposed in the landfills. FMC evaluated this Technical Area assuming gas migration could include radon as well as methane and VOCs.

Technical Area 6 can be restated as: Cover Material Characterization for the FMC Plant OU for the following reasons:

1. The FMC Plant OU is located in a semi-arid climate, which is conducive for installing a capillary barrier cap rather than a clay cap.
2. The performance of RCRA capillary barrier caps installed at FMC supports the installation of a capillary barrier cap, rather than the clay cap.
3. FMC has characterized the borrow areas from which cap material will be obtained (Appendix D). These materials have been used effectively at RCRA WMUs within the FMC Plant OU.

A seventh Technical Area was developed for this evaluation. This Technical Area is "Hotspot Removal and Treatment Evaluation".

In order to consider hotspot removal and treatment, the following questions must all be answered in the affirmative (EPA, 1993):

- Is there evidence for the presence and approximate location of waste?
- Is hotspot known to be a principal threat waste?
- Is the waste in a discrete, accessible part of the landfill?
- Is the hotspot known to be large enough that its remediation will reduce the threat posed by the overall site, but small enough that it is reasonable to consider removal (100,000 cubic yards or less)?

EPA recognizes the potential hazards and technical difficulties associated with characterizing wastes in a landfill. EPA states: "Characterization of a landfill's contents is not necessary or appropriate for selecting a response action for these sites except in limited cases; rather, existing data are used to determine whether the containment presumption is appropriate.... It is important to note that the decision to characterize hot spots should also be based on existing information, such as reliable anecdotal information, documentation, and/or physical evidence (see page 6)." (EPA, 1993).

The existing data regarding waste characterization in FMC's landfills are summarized in Table 6-3.

Technical Area 1 – Waste Area Delineation

The delineation of all three landfills has been performed by reviewing historic air photos to confirm that waste management has not occurred outside the current boundaries, and to determine the boundaries of the former plant landfill beneath the slag pile. At RU 17 and RU 18, the landfill areas have been delineated visually by confirming the extent of the disturbed soils and extent of past excavation.

FMC will continue to dispose unrecyclable construction materials in RU 18. FMC will continue operation of the RU 18 landfill until completion of plant dismantling. RU 17 will no longer be used for disposal of construction material. At this time, FMC anticipates there is sufficient space within the current RU 18 boundaries to contain any unrecyclable construction materials generated during plant dismantling.

The Former Plant Landfill within RU 19 has been inactive and buried with over 40 feet of slag since the late 1960's or early 1970's. The timing of burial is difficult to pinpoint, but the 2003 air photo clearly shows the entire former landfill area seen in the 1965 air photo is covered with slag (Figure 6-20).

RU 19 also contains approximately 17 buried rail cars. These rail cars were filled with sludge in 1964 and hauled up to the slag pile (Figure 6-19). The rail cars are an older generation of tank cars, approximately 30 feet long (compared to 50 feet long for later generation tank cars), and 9.5 feet wide. RU 19 also encompasses the former plant landfill (Figure 6-21).

The reason for sludge disposal in surplus rail cars was explained by former FMC personnel. Apparently, in 1962 the plant became "sludge bound", meaning that the process was not efficiently separating pure P4 from particulates (dirt) in the furnace off-gas, causing the dirt content to be too high. The P4, dirt and other material formed a sludge that could not be reclaimed, and there was insufficient capacity in the existing ponds to contain the excess sludge.

To remove the sludge from the plant area, the rail cars were filled and hauled to the slag pile for burial.

Phosphorus sludge present in the buried railcars is an emulsion of P4, water, and "dirt." P4 globules suspended in water will join and form a continuous layer of elemental phosphorus at the bottom of collection sumps and storage tanks. In the presence of high dissolved solids in water, or impurities (i.e., dirt) carried in the furnace gas stream, the P4 globules cannot bind together and form a continuous layer of P4.

Phosphorus sludge formed when the dissolved solids (ions) and suspended dirt "coat" the P4 globules. This coating prevented the coalescing of P4 globules by preventing the globules from contacting each other. As a result, the globules remained in suspension, forming an emulsion with the water.

Ions and charged dust particles adhere to P4 globules in low pH environments, so sludge formation was more prevalent at pH <3, but would also form at higher pH if there was sufficient dust and ions in the water.

Another factor that influenced sludge occurrence is the rate of cooling in the primary condenser. Faster cooling rates led to smaller P4 globules, which would not coalesce as readily as larger globules.

The sludge buried in the railcars was excess sludge generated in 1962 to 1964 when the FMC furnaces and/or condensers were not operating optimally. There were too many impurities in the process not allowing P4 product to adequately settle out. Instead, a significant quantity of P4 globules was emulsified into sludge. Excess phosphorus sludge was temporarily stored in 30 railroad tank cars, specifically purchased for this storage. The contents of these railcars were reprocessed after process improvements had been implemented. FMC personnel emptied all 30 railcars to recover P4 product but left the phosphorus sludge in the railcars for expected removal during subsequent railcar cleaning.

After P4 product recovery was completed and the railcars were no longer needed for storage, nine of the 30 railcars were completely cleaned of phosphorus and phosphorus sludge and these cleaned railcars were sold for scrap. However, several "near miss" safety incidents associated with cleaning of these railcars in 1964 resulted in a decision not to attempt to clean but rather to bury the remaining 21 railcars at the south end of the slag pile (per the configuration of the slag pile in 1964). In the late Fall of 1964, the remaining 21 railcars were removed from their trucks, hauled to the slag pile, and buried with clay, then covered by slag. Subsequently, the railcars were further buried under the east slag pile as it advanced south. The location of the buried railcars is currently covered with a minimum of approximately 50 feet and a maximum of over 100 feet of slag.

The location of these buried railcars is documented in an aerial photo taken in June 1965, which shows seventeen identifiable, partially buried railcars. The tank dimensions are 30' in length by 9.5' in diameter. This yields a volume of 1703 cubic feet per rail car. The aggregate volume of all 21 railcars would be,1,325 cubic yards [(21 x 1703) / 27 cubic ft per cubic yd]. Current FMC personnel familiar with phosphorus reprocessing activities believe that the railcars may have contained phosphorus sludge at 50% to 75% of the railcar capacity. Thus, the amount of buried phosphorus sludge may range from 662 cubic yards (if 50% full) to 1,325 cubic yards (if 100%

full).Due to the P4 and potentially mobile metals in the sludge, FMC proposed to treat the burial area as a landfill and apply the presumptive remedy to this area of RU 19.

Technical Area 2 – Slope Stability and Settlement

Because there are no existing caps at RU 17 and RU 18, slope stability will be a design parameter for the SFS or RD phase of the project. RU 18 does have an existing soil cover with minimal slope over the inactive portions of the landfill. However, the essentially flat-lying nature of this soil cover does not require a slope stability analysis at this time.

Settlement of the waste mass is a concern due to uneven distribution of waste types, varying degrees of volume reduction during decay of the waste, and differential settling of the overburden. FMC has evaluated differential settling at several RCRA ponds that were capped in recent years, and the final caps have had survey monuments installed to monitor ongoing settling of the buried waste. This same approach can be implemented at the plant landfills to ensure differential settling does not lead to cracking of the cover or allow ponding of water on the surface.

At the former plant landfill in RU 19, the slope stability of slag can be confirmed from previous analyses, and the slopes will not exceed 3:1. Differential settling at the former plant landfill is unlikely to be a concern because the landfill has been compacted with over 40 feet of slag overburden in place since the late 1960's or early 1970's (over 35 years). This overburden should have compacted the underlying waste volume to the degree that ongoing settling will be minimal, if present at all. Similarly, the 50 feet of slag overburden on the buried rail cars should have a similar effect, meaning there will be little, if any differential compaction of rail cars and waste.

Technical Area 3 – Gas Generation/Migration

This technical area is primarily concerned with the potential for methane and VOC migration to structures, where it can accumulate. Sufficiently high gas concentrations can lead to explosive conditions, or displace oxygen and produce an oxygen-deficient environment. Another concern related to gas migration from landfills is that the gases can affect vegetation growing in the soil covers. High gas fluxes can displace oxygen from the root zone, and asphyxiate the plants, and some VOCs may be toxic to plants.

The landfills at FMC are located south of the slag pile, in an area of the FMC Plant OU that is considered much less likely to be redeveloped. In addition, the building design requirements to prevent radon buildup that are currently in force as deed restrictions will prevent the buildup of methane and VOCs in any future structures that may be built near the landfills.

There are two key points that affect the decision to collect soil gas measurements to characterize gas migration potential. First, the landfill contents must have a sufficiently high organic content to generate methane. Second, the landfill must contain sufficiently high quantities of VOCs to act as a soil gas source for the diffusion and migration of VOCs as a gas to a structure. At RU 17, there is no evidence to indicate that FMC used this for disposal of VOCs or material that could degrade and produce methane. The materials at RU 17 are characterized as building material (concrete, steel, and wood) and furnace dig-out material generated as waste during construction projects at the FMC plant. These materials do not produce methane in sufficient quantities or rates to be of concern, and therefore, RU 17 is unlikely to act as a source for methane or VOCs.

At RU 18, the plant practice was to store spent solvents and have them hauled off-site for disposal, so the volume of VOCs in the landfill are likely insufficient to produce a soil vapor plume that could impact nearby structures. Methane generation potential at RU 18 is also considered minimal; although it is likely some methane will be generated as paper and cardboard decays. Even if methane or VOCs migrate from the landfill area to a future structure located nearby, the radon control measures required for future buildings within the FMC Plant OU will limit the potential for VOC or methane buildup in these structures.

The former plant landfill in RU 19 is likely to contain a greater volume of spent solvents compared to RU 18, and may be a methane source. Future buildings that may be constructed in this area would have over 40 feet of vertical separation (slag) between the foundation and potential VOC sources within the former landfill, which would provide some degree of attenuation and dilution of gases emanating from the landfill. The buildings would require radon control design features, further reducing any potential intrusion of VOCs and methane into the structure.

Technical Area 4 – Existing Cover Assessment

Assessment of the existing cover is required when considering the presumptive remedy to determine if the existing cover is sufficient to utilize in the final cap design. In other words, if the soil covering a landfill or parts of a landfill is sufficiently thick, and the material is suitable for a cover layer, it can be integrated into the cap. If the existing cover is inappropriate, such as clay prone to cracking during dry periods, then it should not be integrated into the final cap design because it will not serve to reduce the infiltration potential of the cap.

Portions of the Recyclable Material Landfill, RU 17, are covered. The remaining portion does not have an existing cover. Because RU 17 and RU 18 are likely to be expanded to dispose of unsalvageable building material during plant decommissioning, an assessment of the existing cover should be performed after the landfill ceases operation.

Several cells at RU 18 have a soil cover. The soil is native soil excavated from within the footprint of RU 18, and is similar to the soil characterized for the RCRA pond covers. The soil map presented in the RI Report shows that soils in the RU 18 area are the same soil type as the soil from the RCRA cap borrow area. The permeability and sieve analyses from the RCRA cap soils are in Appendix D, and the data are summarized in Table 6-4. The uncovered cell has no cover that can be assessed at this time. It is likely that it, too, will have an initial cover of native soil placed over the waste.

RU 19 is covered by 40 to 60 feet of slag. FMC plans include recontouring the slag pile, with slopes of 3:1 (horizontal:vertical). This recontouring will maintain a minimum of 40 feet of slag over the Former Plant Landfill. Given the overall coarse grading of the slag and its uniform consistency, it will be analyzed as part of the final landfill cover design. In other words, the final cover design will integrate the slag into the landfill cover and be designed to minimize infiltration through the waste.

Technical Area 5 – Surface Water Run-on/Run-off Management

The surface water run-on/run-off effects of the cap configuration at RU 17, 18, and 19 must be considered within the overall FMC Plant OU surface drainage pattern. Remedial action at one RU must not induce ponding over other potential source materials or increase the erosion potential in other parts of the FMC Plant OU. Surface water management is a design issue that will be addressed in the SFS or RD/RA phase.

Technical Area 6 – Cover Material Characterization

As noted in Technical Area 4, the soil used for RCRA caps at FMC has been characterized, and this same material would be used for the soil covers at the landfills.

The permeability data are summarized in Table 6-4.

Technical Area 7 – Hotspot Removal and Treatment

The criteria used to evaluate the feasibility for hotspot removal within a landfill are summarized against the information for each landfill. Included in this summary are the buried rail cars within RU 19, because the presumptive remedy of containment appears to apply to the sludge contained in the rail cars.

As shown in Table 6-5, the criteria are not met. A negative response means that hotspot remediation should not be considered as part of the presumptive remedy. And all the landfills within the FMC Plant OU should be considered for containment without hotspot removal.

Further supporting a containment remedy for the buried railcars is the fact that they contain P4-containing sludges. The EPA's TIP report concluded that treatment of these sludges is not technically feasible, and a containment remedy is the most suitable alternative. Even if the railcars could be excavated and removed, treatment of the sludges would not be feasible.

Summary

A summary of the RI/FS Technical Areas for the FMC Plant OU landfills is presented in Table 6-6.

FMC has identified an FS data gap associated with radon emission rates through a soil cover on the slag pile. Radon flux measurements will be collected during the SRI to support the SFS.

FMC will also review the existing geochemical and hydrogeologic data as part of the SRI. This review is intended to address uncertainties associated with groundwater flow directions in the area of the slag pile, former plant landfill, and buried railroad cars.

6.1.4 Other Remediation Units

This section discusses the RUs that are not classified as Old Ponds, Landfills, or Former P4 Working Areas. The RUs discussed in this section include:

- RU 3 – Receiving Stores, Paint Shop, and P4 Decon
- RU 4 – Office Buildings and Training Center
- RU 5 – Lab and Old Drainfield
- RU 7 – Shale Unload, Crushing and Stockpile
- RU 9 – Silica Stockpiles and Former Kiln Scrubber Overflow Pond
- RU 10 – IWW Pond and Ditch
- RU 11 – Equipment Area South of Calciners
- RU 12 – Former RP&S Area and Mobile Shop

- RU 13 – Pond 8S Recovery Process & Metal Scrap Preparation Area
- RU 15 – Oversize Ore, Used Electrode, Baghouse Dust Area
- RU 20 – Former Bannock Paving Area
- RU 21 – Other Onsite Railspurs
- RU 23 – Road segments not within RU Boundaries

A summary of the available datasets for soils in each RU is presented in Table 6-7. These datasets served as the starting point for statistical analysis, based on the DQO Process discussed above.

Methods:

First, the soil data at each RU was compiled. In some cases, source characterization data were also added to the RU-specific dataset because the presence of certain materials was observed during the RI. For example, at RU 20, slag was observed in the surficial fill material, so the six composite samples of slag characterized during the RI were added to the RU 20 dataset for comparison purposes. In addition, portions of RU 20 were used for ferrophos crushing, storage, and loading, so the RI composite sample for ferrophos was added to the dataset for RU 20.

Analytical data were also reviewed for data quality to determine that:

1. The detection limits were lower than levels of concern (RBCs, background, etc.)
2. There were no "R" flagged data in the dataset, "R" = analytical results rejected during the QA process. The "R" flagged data were not used in the statistical analyses.
3. Data were collected at locations across the Exposure Area, or RU, not centered in one area.
4. The sample depths corresponded to depths defined to be in an exposure pathway for one or more of the future exposure scenarios (i.e., sample depths greater than 10 feet were excluded because these soils are not considered to be in an exposure pathway, current or future).

Data were grouped to determine whether or not there was sufficient data collected to characterize various exposure scenarios. For example, future site workers may be exposed to soils in the upper 2 feet, whereas future construction and utility workers may be exposed to soils to depths of 10 feet below grade.

Once the data were grouped by depth (0-2 feet and 0-10 feet), the distribution of each constituent was checked using the Shapiro-Wilk Test, which was performed with EPA's ProUCL software at the 95% confidence level. Data distributions fell into three categories; normal distribution, lognormal distribution, or unknown distribution. The distribution for datasets with 4 to 9 samples was not checked. Instead, the 95% UCL was calculated using the non-parametric Chebyshev method, which is independent of distribution assumptions.

Then, the 95% Upper Confidence Limit about the mean value was calculated using the ProUCL software. Table 6-8 summarizes the statistical tests used for the various data distributions encountered.

For data values reported with a "U" or "UJ" qualifier, meaning the constituent was "not detected" at the reported value, the full value of the reported detection limit was used in the data set when performing the calculations or testing the data distributions. The treatment of "nondetects" is described in EPA Guidance (EPA, 2002). In cases where there were 10 or more samples in a dataset, and 15% or more of the data were reported as "not detected", no tests for distribution were performed, and a non-parametric method was used to calculate the 95% UCL of the mean.

Once the 95% UCL of the mean was established for each inorganic parameter, the 95% UCL value was compared against the RBC for the parameter, and the difference was defined as the "delta" value for testing whether or not sufficient samples had been collected for a valid comparison. These tests were done only in cases where the 95% UCL of the mean was 10% or more of the RBC value.

RU 20 Example:

Dataset Description – 10 soil samples, 6 slag composite samples, 1 ferrophos composite sample (total = 17).

Question: Do the materials contained in depth intervals 0-2 feet and 0-10 feet contain inorganic constituents above the RBCs?

Step One: Determine data distributions for various groupings of data. Slag and ferrophos results were included in all depth ranges because slag occurs from 0 to 7 feet bgs, and ferrophos occurs at ground surface (possibly to depths of 1 foot due to mechanical mixing while loading).

Step One Results are shown in Table 6-9 for the various sample groupings.

For 0-2 feet, there were no soil samples analyzed at RU 20. However, there were six slag composite samples and one ferrophos composite sample analyzed during the RI. Because slag fill and ferrophos are present across RU 20 to depths of 1 to 7 feet, and because ferrophos was crushed, stored, and loaded within RU 20, it is believed these samples are representative of site conditions for inorganic constituents in the upper 2 feet across the site.

Step Two: Using the appropriate method, calculate the 95% UCL about the mean for each constituent being analyzed.

Where 10 or more samples were available, the distribution of the dataset was analyzed using the Shapiro-Wilk method to determine if the distribution was normal or lognormal. If the data were not normally or lognormally distributed, a non-parametric technique was selected to calculate the 95% UCL. When the data were determined to be normally or lognormally distributed at the 90% confidence level, the 95% UCL was calculated using the student's t method.

The Chebyshev method was the selected non-parametric technique selected for calculating the 95% UCL where the distribution could not be determined.

When the dataset was comprised of 4 to 9 samples, a non-parametric approach was used for calculating the 95% UCL of the mean concentration. The Chebyshev method, which is typically the most conservative (i.e., highest), was selected for the appropriate value of the 95% UCL.

The 95% UCL for sample sizes less than 4 were not calculated, and for these RUs, a data gap was identified, and additional samples will be collected as part of the SRI. The sampling design will be described in detail in the SRI Work Plan, and will follow the EPA's DQO Process.In the example for RU 20, the native soils were analyzed separately from the slag samples because these materials are not from the same population. This can be readily seen when testing the distribution of the data. Concentrations in slag samples are normally distributed for many of constituents at the 90% confidence level. Similarly, the native soil samples show normal or lognormal distributions for many constituent concentrations. When the datasets are combined, the distributions are bimodal, and cannot be considered normal or lognormal.

The 95% UCL for the slag and native soil concentrations were compared to the future site worker RBCs separately.

While Gibbons (2003) advocates sample sizes of 20 or more to achieve adequate power for conducting statistical tests, it should be noted that the power of these tests relates to accepting the null hypothesis as true when it is false. In cases where the 95% UCL of site materials exceed an RBC, FMC will determine if additional characterization is warranted to reduce their risk of having to conduct a remedial action where it may not be needed. In some cases, it is considered unlikely that additional data will alter the outcome, even though the sample size may not have sufficient power.

Step Two Results are shown in Table 6-10, Table 6-11, Table 6-12.

Step Three: Calculate the delta (gray region) by subtracting the 95% UCL about the mean from the RBC. Because there are four RBCs calculated for each COPC, plus one representative level (background) for each COPC, five delta values were calculated.

Delta 1 = Difference between 95% UCL and RBC from 1996 HHRA (exposure interval from 0-2 feet)

Delta 2 = Difference between 95% UCL and updated RBC for future site worker (exposure interval from 0-2 feet)

Delta 3 = Difference between 95% UCL and updated RBC for future site construction worker (exposure interval from 0-10 feet)

Delta 4 = Difference between 95% UCL and updated RBC for future site utility worker (exposure interval from 0-10 feet)

Delta 5 = Difference between 95% UCL and representative level of constituent in soils

Step Three Results are shown in Table 6-13, Table 6-14, Table 6-15, Table 6-16, and Table 6-17.

Step Four: Calculate the number of samples needed to test the null hypothesis "95% UCL about the mean exceeds RBCs" at the 5% Alpha Level, and 10% Beta Level. The alternative hypothesis is "95% UCL about the mean does not exceed the RBCs (or representative levels)". The alpha level is the potential for a Type I error, or probability that a site is classified as not exceeding RBCs when in reality it exceeds RBCs. The Type II error, or beta level, is the probability that the decision was made that site soils exceed RBCs when in reality they do not.

Where 10 or more samples were available, the Shapiro-Wilk normality test was performed. If the samples indicated a normal or lognormal distribution was evident in the underlying population, then the equation below was used to calculate the number of samples required to support the decision:

$$n = \frac{s_{total}^2 \left(Z_{1-\alpha} + Z_{1-\beta}\right)^2}{\Delta^2} + 0.5Z_{1-\alpha}^2$$

When there were between four and nine available samples, a non-parametric equation was used to analyze whether or not sufficient samples had been collected to support the decision. The equation below was used for cases where a normal distribution is not assumed:

$$n = 1.16\left[\frac{s_{total}^{2}\left(Z_{1-\alpha} + Z_{1-\beta}\right)^{2}}{\Delta^{2}} + 0.5Z_{1-\alpha}^{2}\right]$$

No tests for the adequacy of sample size were performed when the 95% UCL of the mean was less than 10% of the RBC or comparison value. For example, if the 95% UCL of the mean was 4.3, and the RBC was 52.2 (4.3 is less than 5.22, which is 10% of the RBC), no tests for sample size adequacy were performed. No tests for sample size adequacy were performed for comparisons against background levels.

A further assumption underlying the calculations for sample size is that the samples are not correlated in space or time. Given the homogeneity of native soils observed in numerous borings throughout the FMC Plant OU, spatial correlation can be ruled out for native soils. Furthermore, the homogeneity of fill also precludes spatial correlation in the distribution of inorganics for media within exposure pathways (i.e., 0-10' depth intervals). Fill material is typically a mixture of slag and native soils. In RU 7, RU 9, and RU 10, fill is typically a mixture of ore and native soils. Slag is found on some roadways within these RUs.

Step Four Results are shown in Table 6-18.

Step Five: State the decision: Slag, ferrophos, and soils are sufficiently characterized at RU 20 to support the decision at the specified Type I and Type II errors.

In other words, none of the inorganic constituents exceeded the updated RBCs for future and/or current exposure scenarios, with the exception of arsenic. However, arsenic is sufficiently characterized to reject the null hypothesis when comparing against background (7.7 mg/kg) and accept the alternative hypothesis, that arsenic concentrations in the potential exposure pathways are less than the representative levels.

Thallium may be a potential concern in the Future Site Worker pathway because the analytical results for slag and ferrophos were rejected during the RI QA data review. The soil data from other areas of the FMC Plant OU indicate exposure to thallium will be much lower than the RBCs for Site Construction Workers and Site Utility Workers at depths below the slag fill.

Similar steps were followed to determine whether the site was adequately characterized for gamma radiation measurements.

RU 20 – Former Bannock Paving Area

The following discussion of RU 20 is summarized in Figure 6-22. FMC's remediation vision for RU 20 is No Further Action anticipated to be necessary.

As noted in Section 2, the CSM indicates some uncertainty associated with potential hydrocarbon sources to groundwater. Several of these potential sources are located within RU 20.

Since the EMF RI was completed, there have been no reported spills or releases within RU 20 (Figure 6-23). Some slag and ferrophos piles remain within RU 20, however, all fuel tanks and asphalt production equipment has been removed.

An alleged spill was investigated in 1997 by the Jack B. Parson Co. and the results show that TPH was present in one sample collected in the slag backfill at concentrations below action levels. Eight other samples collected during this investigation did not contain detectable levels of hydrocarbons.

Inorganics do not exceed updated RBCs for the three exposure scenarios evaluated (Appendix C). The decision is supported at the 95% confidence level.

During the EMF RI, elevated levels of nitrate were detected in groundwater samples from Well 139, located approximately 450 feet west of the coke drying scrubber basin. The source of this nitrate was not confirmed during the EMF RI. Subsequently, a potential source has been identified. Wet coke was stockpiled in the area of Well 139 before the coke was dried prior to introduction into FMC's production process. Coke production is a major source of ammonia sulfate, a fertilizer compound, and wet coke can contain a significant amount of ammonia because it has not been fully dried. The wet coke stockpile was not covered or lined, so precipitation could infiltrate the wet coke, oxidize and leach ammonia, and ultimately transport it to the uppermost aquifer. The Eh in the vadose zone would also allow mobilized ammonia to oxidize to nitrate as it was transported through the vadose zone.

The gamma radiation measurements are insufficient to support a decision. Twelve additional readings would be required to determine if the site exceeds gamma radiation levels. Because external gamma radiation makes up over 90% of the incremental cancer risk, the appropriate data for characterizing cancer risks associated with radionuclides at RU 20 is the gamma radiation measurements. These measurements account for all gamma emitters, rather than extrapolating gamma radiation from radionuclide concentrations measured in discrete or composite soil samples.

Residual coke remains on the ground surface near the coke drying facility. There is no available analytical data, other than a TCLP analysis, to characterize the coke.

Insufficient samples were collected to support a decision that all potential fuel release sites have been adequately characterized, nor has the potential for releases through the septic system been investigated.

Data Gaps

Additional data are needed to characterize potential hydrocarbon releases in areas where BAPCO maintained above-ground fuel storage tanks. Characterization of potential releases will include an evaluation of potential groundwater impacts, if there is evidence of vertical migration to sufficient depths.

Additional measurements are needed to characterize gamma radiation within RU 20 to support a valid statistical comparison with background levels. The number of gamma measurements will be detailed in the SRI Work Plan through the application of the DQO Process.

Characterization of residual coke is needed to support a decision to either forward RU 20 to the SFS or determine that no further action is needed. This characterization will include leachability testing for ammonia and nitrate to confirm the source of elevated nitrate in Well 139.

There is a lack of data needed to characterize radionuclides associated with phossy solids that may be present within portions of RU 20. Lead-210 and polonium-210, radionuclides associated with phossy solids, will be characterized through the use of field XRF analyses, described in Appendix H.

RU 3 – Receiving Stores, Paint Shop, and P4 Decon

Figure 6-24 summarizes the following discussion of RU 3. FMC remediation vision for RU 3 is "no further action anticipated to be necessary".

The buildings within the RU 3 footprint were in use during the RI, and continued in use through 2002 (Figure 6-25). The paint shop is no longer used, and the receiving area is used for storage of safety equipment.

The P4 Decon building was put into service after the EMF RI was completed, and is still in use. The P4 Decon building is used to remove P4 from equipment, piping, etc. before being shipped offsite for re-use/recycling. It is operated under RCRA, no spills or releases have been reported, and FMC will close the facility under RCRA standards after plant decommissioning.

Phossy water releases in RU 1 (Phos dock and furnace building) may have affected the RU 3 area. A storm drain connects RU 1 and the Railroad Swale, and this drain runs through RU 3. Several phossy water releases occurred that may have entered the storm drain, and if the storm drain leaked, some P4 and other constituents may be present near the storm drain.

The boiler fuel tank was removed from service, and confirmation soil samples, collected during tank removal, show that no residual hydrocarbons above action levels remain in surrounding soils.

Statistical Summary

There were insufficient soil samples collected to statistically evaluate the soil concentrations against RBCs or background levels.

Data Gaps

Statistical analyses of the existing data could not support a decision as to whether or not constituent concentrations in site soils exceed RBCs. Only two soil samples are available in RU 3 that could be used to characterize the site construction worker exposure scenario. Additional samples are needed to characterize inorganic constituent concentrations in the 0-2 foot interval and the 2-10 foot interval.

Evaluation of the storm drain condition is a data gap that will be addressed in the SRI. Video inspection of the storm drain will help determine its integrity, and if leaks are identified during this inspection, P4 sampling will be performed around the storm drain.

There is some evidence that slag was used as fill within RU 3. Gamma measurements will be needed in RU 3 to characterize the gamma radiation potential. The number of gamma measurements will be detailed in the SRI Work Plan through the application of the DQO Process.

Although lead-210 and polonium-210 are not identified as COPC's in Table 6-1 for RU 3, the XRF screening method for phossy solids will be conducted at RU 3 during the SRI to confirm that phossy solids and the associated radionuclides are not present at levels of concern.

RU 4 – Office Buildings and Training Center

Figure 6-26 summarizes the following discussion on RU 4. The remediation vision for RU 4 is "no further action anticipated to be necessary". However, during the EMF RI, toluene was detected in boring F028B in low levels in all sampled soil horizons. The VOCs detected in F028B are thought to be associated with the Chem Lab Seepage Pit (SWMU 39). Although the EMF RI concluded that there were was no indication of a VOC source to groundwater, there is some uncertainty and additional characterization will be needed.

There were no additional source mechanisms identified in the post-RI period. The septic system serving the plant buildings was emptied and backfilled in 1995, when the plant connected the sanitary lines to the Pocatello sewage treatment plant.

Plant piping drawings indicate that underground phossy water piping is not within RU 4 boundaries.

The EMF RI found slag fill in the shallow intervals in most borings drilled within RU 4 (Figure 6-25). The analyses of these samples identified some constituents above representative levels. Based on the EMF RI findings at roads and rail spurs in the FMC Plant OU, it is likely that rail lines and roads within RU 4 are underlain by several feet of slag.

The EMF RI did not identify any potential contaminant sources to groundwater within RU 4. Site-related constituents associated with the slag fill and the application of IWW water for irrigation were identified in shallow intervals, but they were attenuated at depths of 10 to 20 feet.

The laboratory seepage pit was investigated during the EMF RI as a potential source of organic compounds. Boring F028B was sampled and analyzed for organic compounds. The EMF RI concluded that there was no source of organic compounds to groundwater, and no soil impacts associated with the laboratory seepage pit.

Gamma radiation readings were made during the EMF RI, one indoor measurement and one unshielded outdoor measurement. The unshielded reading was 20 microrem/hour, which exceeds the background level of 13 microrem/hour.

Statistical Summary

There were insufficient data in the 0-2' interval to statistically evaluate whether or not concentrations of inorganic parameters exceed the RBCs.

In the 0-10' interval, the soil concentrations do not exceed the Construction Worker RBCs or the Utility Worker RBCs at the 95% confidence level.

EMF RI background concentrations for several parameters were exceeded at the 95% confidence level. Several parameters were below background levels; however, for many parameters, a statistical comparison was not supported by the number of available samples.

Data Gaps

Additional gamma radiation measurements are needed to characterize gamma radiation effects in the RU 4 area. The number of gamma measurements will be detailed in the SRI Work Plan through the application of the DQO Process.

Additional soil samples are needed to characterize the 0-2' soil interval. These data will support a statistical comparison between the site soil concentrations and the Updated Site Worker RBCs.

As noted for RU 3, there is no evidence that phossy solids were disposed or stored within RU 4; however, the XRF screening method described in Appendix H will be performed during the SRI.

RU 5 – Lab and Old Drainfield

The discussion of RU 5 is summarized in Figure 6-27. The remediation vision for RU 5 is "no further action anticipated to be necessary".

SWMU #61, the disposal area behind the laboratory, is also located within the RU 5. This area has been identified as a potential source for solvents and metals. There may have been some disposal of free liquids in this area, which is now covered with sidewalks and a parking area.

The EMF RI targeted the laboratory seepage pit at RU 5 as a potential source of inorganics and VOCs (Figure 6-25). The seepage pit received laboratory acids and solvents used in the preparation of ore samples for analyses. In 1980, the disposal of laboratory waste ceased, and in 1995 FMC grouted the seepage pit to prevent migration of any remaining metals or solvents.

A review of the site history since the 1998 ROD was signed did not identify additional or new potential sources at RU 5.

Statistical Summary

Only one soil sample was available within the depth intervals of concern (0-10'). Therefore, no statistical analyses could be performed.

Data Gaps

Gamma radiation measurements are needed at RU 5 to support the decision for no further action. The number of gamma measurements will be detailed in the SRI Work Plan through the application of the DQO Process. The XRF screening method described in Appendix H will be applied to RU 5 to confirm that lead-210 and polonium-210 are not above levels of concern in RU 5.

Although the EMF RI did not identify the disposal area behind the lab as a potential source to groundwater, additional characterization is needed for VOCs and SVOCs in the shallow soils in order for redevelopment to occur in this area. If VOCs and/or SVOCs are detected, limited hotspot remediation will be evaluated in the SFS. VOC and SVOC potential impacts to groundwater may need additional investigation, depending on the results of the hotspot investigation.

Last, additional soil samples are needed to characterize inorganic contaminants at RU 5 to support the remedial action vision through the DQO process.

RU 7 – Shale Unload, Crushing and Stockpile

The Shale Unload, Crushing and Stockpile area has been used for the same purpose since the plant began operation (Figure 6-28 and 6-29). Although material handling practices have changed (e.g., ore was originally handled with bulldozers, and later with the stacker/reclaimer wheel), the material stored within the boundaries of RU 7 has always been ore.

The source for the ore has been the Phosphoria Formation from two mines in the region. The Gay Mine was the source of ore from 1949 through 1993, and Dry Valley Mine was the ore source since 1993.

No other potential sources, spills, or releases have been reported at RU 7 since the EMF RI was completed. RU 7 is not a P4 handling or storage area, so P4 is not a constituent of concern at this RU.

FMC has recently sold the ore, and it will be removed from the RU 7 area. Once removed, the area will be graded for potential future reuse. The remediation vision for this RU is "no further action anticipated to be necessary".

Statistical Summary

The soil data for RU 7 were analyzed to determine if sufficient samples have been collected and to compare the 95% UCL of the mean concentrations for inorganics against the RBCs.

The statistical comparisons showed that arsenic exceeds the 1998 RBC, the Updated Site Worker RBC, the Construction Worker RBC, and background levels. The arsenic concentrations do not exceed the Utility Worker RBC. Cadmium concentrations also exceed the construction worker RBC within RU 7, and there are insufficient data to support a decision regarding fluoride concentrations in the 0-10' interval at RU 7.

Other inorganic parameters do not exceed RBCs, although several exceed the EMF RI background levels (Appendix C).

Data Gaps

After removal of the ore, confirmation sampling will be performed to characterize residual levels of arsenic and cadmium in the 0-10' depth interval. Gamma measurements will be used to characterize external gamma exposure associated with radionuclides in the ore. Sample locations and the sampling approach will be documented in the SRI Work Plan.

The XRF screening method in Appendix H will also be performed at RU 7 to determine if phossy solids may be present in quantities where lead-210 and polonium-210 could be a concern.

Coke has not been characterized at RU 7, and the nature of coke used by FMC will be characterized to evaluate a decision of no further action. The vertical extent of the coke will be assessed to determine if mechanical mixing with shallow soils has occurred.

RU 9 – Silica Stockpiles and Former Kiln Scrubber Overflow Pond

The discussion that follows is summarized in Figure 6-30. RU 9 was largely used for silica stockpiling and handling. From approximately the 1950's through the late 1960's, the kiln scrubber overflow pond was operated within RU 9 (Figure 6-31). In the late 1960's, FMC installed calciners, and the kiln scrubber overflow pond was backfilled with silica.

Silica was formerly a process feedstock and is a naturally-occurring weathered quartzite that was mined at the Wells Cargo Mine, approximately 7 miles south of the FMC facility. Silica was crushed and screened at the mine then stockpiled on the plant site. Silica used in the elemental phosphorus process had a typical diameter ranging from 0.5 to 1.5 inches.

There are no records to confirm if pond solids were removed prior to backfilling, or to determine if any appreciable volume of solids had accumulated. Because the pond received clarified overflow water from the kiln scrubber ponds, it probably did not accumulate a large volume of solids. As described in the discussion of RU 8, the former kiln scrubber overflow pond and portions of the ditch are included in RU 9.

During the EMF RI, boring F054B was drilled through the silica stockpile, within the former pond footprint. The boring log shows 40 feet of silica fill was encountered before native soils. Should the stockpile be leveled to pre-existing grade, there would be over 15 feet of silica fill remaining over the former pond. However, the perimeter or pond edges may contain kiln solids that would remain within an exposure pathway for construction workers and utility workers.

Most roadways within FMC were constructed with a slag road base. Road segments within RU 9 may also have slag road base, and these road segments were not characterized during the EMF RI.

Statistical Summary

Soil samples collected from within RU 9 were compared to the various RBCs and the EMF RI background levels, where possible.

There were insufficient samples to evaluate the RBCs associated with the 0-2' interval (1998 RBCs and Updated Site Worker RBCs).

The cadmium concentrations at the site exceed the Construction Worker RBCs, and there was insufficient data to compare arsenic and fluoride site concentrations against the Construction Worker RBCs.

None of the inorganic constituents exceeded the Utility Worker RBCs.

Several inorganic parameters exceeded the EMF RI background levels, while several did not. In some cases, there were insufficient samples to conclude whether or not concentrations in site soils exceeded background.

Data Gaps

Additional characterization of the former kiln scrubber pond and ditch is needed to determine if inorganic constituents are above the RBCs within the exposure pathways.

General area site soils also need further inorganic constituent characterization to support the DQO process.

Gamma radiation measurements are needed to determine if the remediation vision can be supported. The number of gamma measurements will be detailed in the SRI Work Plan through the application of the DQO Process.

The XRF screening method described in Appendix H, will be used to characterize the 0-10' depth interval to evaluate the potential presence of phossy solids. The SRI will also investigate the feasibility of using XRF screening to delineate kiln solids, if residuals are present within the footprint of the former kiln scrubber overflow pond.

RU 10 – IWW Pond and Ditch

The IWW pond and ditch began operation in 1977 for the disposal of non-contact cooling water from the calciners and furnaces (Figures 6-31 and 6-32). Prior to 1977, FMC had placed non-contact cooling water in their ponds.

FMC operated the IWW system under an NPDES permit, and in 2002 FMC requested EPA to terminate the permit because the IWW system was no longer in use.

As noted in the summary, there were infrequent plant conditions where small volumes of phossy water were routed to the IWW system. FMC investigated the cause of the releases, and reconfigured plant piping to reduce the potential that phossy water would be routed to the IWW system.

Minor amounts of P4 may have been released to the IWW system, and residual P4 may be contained in sediments that remain in the pond and ditch. Sediments that were dredged and placed at the pond and ditch edges likely no longer contain P4 due to the oxidation of P4 as these sediments dried.

Statistical Summary

Two soil samples were collected from boring F030B in the 0-10' interval, near the IWW Pond and six sediment samples were collected from the IWW ditch during the EMF RI.

The sediment data were not used in the statistical analysis because the IWW system operated from the period of the EMF RI through 2002, and the sediments sampled during the RI were probably dredged from the ditch. In addition, it is difficult to determine if these sediment samples would characterize a particular exposure scenario because the ditch has been backfilled with varying thicknesses of fill.

Therefore, insufficient soil samples are available to perform the statistical comparisons between site conditions and RBCs.

Data Gaps

There are insufficient data to determine if IWW sediments remaining in place after backfilling contain site-related constituents that exceed RBCs. The dredged sediments placed along pond and ditch edges have not been characterized sufficiently to determine that they do not contain constituent concentrations above RBCs.

Given the potential for past P4 releases through the IWW system, sampling for P4 should be conducted to characterize the pond and ditch sediments (those remaining in place, and those sediments dredged and placed along the pond and ditch edges). The P4 releases may have been associated with phossy solid releases, therefore, the radionuclides lead-210 and polonium-210 will be characterized in RU 10, as outlined in Appendix H.

Slag fill was used plant-wide for road base, and RU 10 is bounded by roads. Slag is a known gamma source, and gamma radiation measurements will be collected to compare site conditions against background gamma levels.

The number of gamma measurements and soil samples will be detailed in the SRI Work Plan through the application of the DQO Process.

RU 11 – Equipment Area South of Calciners

RU 11 is summarized in Figure 6-33 and shown in Figure 6-34. It is approximately 8 acres. The site was used for equipment storage and an equipment staging area in the past. There are no records or other evidence that FMC performed equipment maintenance within RU 11, so hydrocarbons and VOC's do not appear to be COPCs.

The primary concern associated with RU 11 is gamma radiation potential from slag in the road base. The EMF RI also found that areas within the FMC Plant OU had other site materials (ore and precipitator dust) mechanically mixed with native soils to depths of 2 to 5 feet in some areas.

Statistical Summary

There were no available data to use in a statistical comparison with RBCs, or to compare gamma radiation potential against background levels.

Data Gaps

Gamma radiation and inorganic constituent concentrations in shallow soils (0-10') are the two data gaps that will be addressed in the SRI. In order to support the remedial action vision, the data gaps will be addressed in a manner that supports the DQO process.

RU 12 – Former RP&S Area and Mobile Shop

Figure 6-35 summarizes the following discussion of RU 12, and the site is shown in Figure 6-36. Multiple site uses have occurred at RU 12 through the course of operations at the FMC Plant OU. Transformer salvage, PCB storage, fuel storage, phossy water pipeline cleaning, and other activities have all occurred within the RU 12 boundaries.

The EMF RI investigated the pipeline cleanouts located in RU 12. These pipelines transported phossy water to the ponds, where the solids were allowed to settle. Cleanouts were placed to access these pipes in the event they became clogged with phossy solids.

Inorganics and radionuclides were analyzed from soil samples collected around the pipeline cleanouts. The typical suite of phossy water constituents were detected in the shallow soil samples (cadmium, fluoride, zinc in addition to orthophosphate, arsenic, and several trace metals). Borings were drilled to depths ranging from 7 to 25 feet from grade. A detailed review of the results of this investigation is presented in the EMF RI Report, Section 4.2, pages 97-106

The EMF RI investigated the potential for PCB releases, and no significant PCB levels were identified (EMF RI Report, pages 4.2-97 through 4.2-99). The EMF RI also investigated the potential for phossy water pipeline cleanouts as a potential source (EMF RI Report, pages 4.2-99 through 4.2-106). Evidence was found that the underground pipes had leaked. The below-ground piping system was not investigated as part of the EMF RI; only the areas around the pipe cleanouts were investigated (Figure 6-36).

After the EMF RI was completed, FMC replaced the underground piping with an above-ground pipe system.

During the construction of the LDR, P4 was encountered in the shallow soils and fill. The source of the P4 is the former underground piping that crosses RU 12.

There have been three reported releases of diesel fuel from the fueling station. These have been above-ground releases, ranging from 40 gallons to 572 gallons. FMC personnel responded by placing sand berms around the spill areas, and cleaning up free-phase diesel pooled on the asphalt areas. Some of the diesel may have run off the paved areas and infiltrated the adjacent fill and soils; however, this has not been investigated. During the EMF RI, twelve samples were collected and analyzed for TPH from depths of 0 to 2 in six different locations (F060B, F061B, F105B, F111R, F112R, and F122R). TPH concentrations ranged from 30.1 mg/kg to 9,025.2 mg/kg.

Statistical Summary

Insufficient data were available to perform the statistical comparisons with the 1998 Site Worker and Updated Site Worker RBCs.

The statistical analysis of site data versus the Construction Worker RBCs shows that the 95% UCL of the mean concentrations for inorganics do not exceed the updated RBCs. However, there are insufficient data to compare site media with the RBCs for arsenic and cadmium. None of the inorganic constituents exceed the Utility Worker RBCs at the 95% confidence level. As with most areas of the FMC Plant OU, constituent concentrations in shallow soils exceed EMF RI background levels due to placement of slag, ore, and other materials as fill and mechanically mixing these materials with underlying native soils.

There was insufficient data to statistically analyze gamma radiation against background levels.

No P4 data have been collected to analyze against the updated RBCs.

Sampling has not been conducted to determine potential impacts from the diesel fuel releases, and a hotspot analysis could not be performed.

The PCB sampling pattern at RU 12 was too sparse to perform a hotspot analysis that would support a decision with reasonable error limits.

Data Gaps

Gamma radiation measurements are needed to determine if RU 12 is forwarded to the SFS or if no further action is warranted.

Phossy solids associated with the underground pipelines and pipeline cleanouts will be characterized as outlined in Appendix H. A selected subset of samples will be analyzed for lead-210 and polonium-210.

FMC will evaluate the feasibility of underground pipeline removal within RU 12, which will be a task for the SFS. No data are needed at this time to support this evaluation.

Soil samples should be collected and analyzed in low-lying areas downgradient from the fuel pumps to characterize potential impacts from the past diesel spills, recognizing that diesel fuel likely is within the CERCLA petroleum exclusion.

A hotspot sampling program should be developed to characterize PCBs in portions of RU 12.

RU 13 – Pond 8S Recovery Process & Metal Scrap Preparation Area

The following discussion is summarized in Figure 6-37 and RU 13 is shown in Figure 6-38. The former underground phossy water piping crosses RU 13 in the eastern portion of the site, while the soil borings from the EMF RI are located in the western portion.

RU 13 was the site of the Pond 8S Recovery Process, a system designed to recover P4 from process water before the sludges were placed in Pond 8S. The system was dismantled and closed under RCRA.

FMC used RU 13 as a staging area for their portable storage tank containing dielectric fluid. This unit was emptied and sold for scrap. Oil was removed, placed in drums, and shipped offsite to a used oil management facility.

Currently, the area is used for storage of decontaminated scrap metal.

Statistical Summary

Site Worker RBCs could not be statistically compared to site data because insufficient data are available in the 0-2' interval. The comparisons to Construction Worker and Utility Worker RBCs and background are included in Appendix C. Cadmium concentrations exceed the

Construction Worker RBC, as does arsenic at the 95% confidence level. There are insufficient data to compare site concentrations against Construction Worker RBCs for antimony, fluoride and lead.

Cadmium concentrations exceed the Utility Worker RBC, while none of the other inorganic constituents exceed the Utility Worker RBCs.

Data Gaps

The data gaps that will be addressed in the SRI are gamma radiation measurements; shallow site soils (0-10') for inorganics; and the potential for P4 occurrence along the underground piping in the eastern portion of RU 13.

In addition, confirmation sampling will be conducted around Borings F058B and F059B to determine the extent of the phossy solids at depth, and selected samples will be analyzed for lead-210 and polonium-210.

RU 15 – Oversize Ore, Used Electrode, Baghouse Dust Area

The following discussion on RU 15 is summarized in Figure 6-39, and the site is shown on Figure 6-40. The northern boundary of RU 15 has a common boundary with the southern boundary of the Calciner Pond Remedial Action area. RU 15 was primarily used since the 1970's for storage of oversize ore, calcined nodules, baghouse dust from ore handling facilities within the plant, and used carbon electrodes from the furnaces. The EMF Remedial Investigation Report (Bechtel, 1996) identified a calciner solids storage area, identified as Storage Area A (associated borings F023B, F050B and F128B).As noted in the discussion for RU 16, there are some residual calciner solids within RU 15. More recently RU 15 has received residual coke and silica.

Currently, RU 15 has surficial calciner solids as well as oversized ore, calcined nodules, baghouse dust, and minor amounts of silica and residual coke. Several pieces of broken carbon electrodes are also located in RU 15.

Periodically, FMC would reclaim some of the oversize ore. The larger portions of electrodes were periodically sold. FMC has sampling data indicating there was no P4 within the carbon matrix before selling the electrodes.

FMC's remediation vision of grading and capping RU 15 is focused on reducing the potential exposure to surficial calciner solids, ore, calcined solids, and baghouse dust, and controlling run-on/run-off to prevent migration via surface water runoff. EMF RI data from the RU 7 area (shale ore stockpile area) and other ore feedstock data indicates the material in RU 15 (ore and baghouse dust from ore handling facilities) exceed the RBCs for arsenic and possibly cadmium. Furthermore, the EMF RI borings in the RU 7 area also showed that the metals and inorganic constituents within shale are immobile and do not readily leach from the ore when exposed to precipitation (EMF RI Report, pages 4.2-125 through 4.2-128).

Boring 163B was initially drilled to install a groundwater monitoring well. However, water-yielding material was not encountered. A single sample from a depth of 21 feet was analyzed for selenium. Results for this analysis were ND (1.4 mg/kg UJ). This information was not discussed in the RI Report, but was submitted to EPA during the RI.

Statistical Summary:

There were insufficient soil samples to perform a statistical comparison between site soils and RBCs or background.

Data Gaps

The ore and calciner solids stored within RU 15 were characterized during the EMF RI. However, these site-specific materials have not been adequately characterized to support the SFS. FMC will test the ore, calciner solids and coke for leaching potential. This information will be used during the SFS to support cover/cap design criteria.

Characterization of the vertical extent of contamination within RU 15 is also a data gap. Evaluation of available groundwater data will be performed prior to issuing the SRI Work Plan. Results of this evaluation will be included in the Work Plan to help justify whether or not additional soil borings are needed.

RU 21 – Other Onsite Railspurs

Figure 6-41 summarizes the discussion on RU 21, shown in Figure 6-42. The railspurs that are not within the boundaries of other RUs were identified as potential sources of gamma due to the presence of slag fill. These railspurs do not include the locations of loading and unloading activities; these are addressed as noted in other RUs.

The railspurs were built to support plant operation. Once constructed, the locations have not changed through time. Slag fill was used as railspurs required maintenance and upgrading through the years. FMC received coke at RU 20 and RU 7, slag was loaded onto railcars within RU 20, and ore was unloaded at RU 7. P4 was loaded and unloaded within the boundaries of RU 1 and RU 6. The remaining railspurs were used for railcar staging. Within the boundaries of other RUs the specific materials handled along the railspurs are subject to investigation within these RUs.

The railspurs remain a key infrastructure component for most site redevelopment options, and FMC has no plans to remove the railspurs.

Statistical Summary

No statistical analyses were performed for inorganic constituents within RU 21 because there were insufficient data.

However, an analysis of the slag data (see Appendix C: RU 20) shows that slag does not contain inorganic constituents that exceed the updated RBCs at the 95% UCL. Beryllium concentrations exceed the 1998 RBCs, but the 95% UCL of the mean for beryllium does not exceed the updated RBCs for future site workers, construction workers, and utility workers.

Data Gaps

The EMF RI identified the presence of slag along most railspurs at varying thickness. Because slag is a known gamma source, the scope of the SRI will include characterization of gamma radiation along the RU 21 railspurs.

RU 23 – Road Segments not included in other RUs

Figure 6-43 summarizes the following discussion relating to RU 23. Road segments that do not fall within other RU boundaries can be seen in Figure 3-1. The rationale for classifying road segments within other RUs or within RU 23 was presented in the Scoping and Planning Memorandum (FMC, 2004) and is repeated below:

"Roadways within the FMC Plant OU will be assigned to RUs as follows:

- Roadways coincident with RUs identified as likely capping remedy candidates will be evaluated as part of (i.e., within footprint of) that RU.
- Roadways coincident with NFA candidate RUs will be sufficiently characterized (including collection of new data, as needed) to evaluate and support NFA status.
- Roadway segments not otherwise included in these two classes of RUs will be identified as RU 23 (Miscellaneous roadways) that will be separately evaluated."

These road segments are not located in plant areas where material handling occurred, reducing the likelihood of spills or releases along these road segments. A review of plant records and interviews with FMC employees did not identify any spills or releases along plant roads within RU 23. However, FMC has applied Pond Closure Decant Water (PCDT), pond and decontamination water treated in the on-site water treatment plant, to various road segments for dust suppression (Appendix I). FMC provided EPA with an estimate of the mass loadings of inorganic and radiologic constituents to the roadways associated with the use of PCDT water (FMC, November 21, 2003). The estimated mass loadings show that overall increases to constituent concentrations would be minimal, and the resulting increases would not cause any constituent to increase in concentration above the 1998 RBCs. The mass loading estimates showed arsenic concentrations in shallow roadbase materials would increase by 2.7%, from 18.51 mg/kg to 19.01 mg/kg. The RBC for arsenic is the EMF Site background, which is 7.7 mg/kg. Information on the loading rate calculations and water chemistry can be found in Section 3 of this report.

Similar to the railspurs within the FMC Plant OU, the road locations have not changed much over the course of FMC plant operations. Minor shifts occurred as plant processes were upgraded and facilities added. However, most of these changes occurred within the boundaries of other RUs, and the road routes within RU 23 have remained unchanged once the roads were constructed. In other words, the locations of roads within RU 23 are well-known from air photos, and on-the-ground surveys (Figure 44).

Roads were built with a relatively thick (1 to 3') slag road base to accommodate the heavy equipment used by FMC. In the 1990's, many of the roads were paved to reduce fugitive dust emissions.

Statistical Summary

As with RU 21 (Railspurs), statistical analyses were not performed for inorganic constituents within RU 23 because there were insufficient data. Appendix C (RU 20) includes a statistical comparison between the RBC thresholds against the 95% UCL of mean concentrations in slag for inorganic constituents. There is also a comparison of constituent concentrations and the EMF RI background concentrations.

As shown in Appendix C, inorganic concentrations in slag do not exceed the RBCs, and there were no reported spills of fuels or PCBs along RU 23 roadways. Therefore, additional characterization of these constituents is not required to support decisions relating to the need for remedial actions.

Data Gaps

The EMF RI identified the presence of slag along most roads at varying thickness. Because slag is a known gamma source, the scope of the SRI will include characterization of gamma radiation potential along the RU 23 plant roads. Because the roads are made of a slag road base, FMC believes the inorganics on roadways require no further characterization. However, gamma radiation from slag has not been adequately characterized for individual road segments.

In addition, road segments where precipitator dust may have been applied in the past will be characterized for the potential occurrence of lead-210. Some road segments within other RUs where no further action is the remediation vision (e.g., RU 11 and RU 4), may require lead-210/precipitator dust characterization. Road segments where precipitator dust may have been applied will be identified in the SRI Work Plan, after a more detailed review of the history of plant roadways has been performed. The historical review will identify road segments in use during the period through 1993, when the practice was ceased. Current FMC employees report that precipitator dust application in winter months was infrequent, and occurred only when conditions on plant roadways were extremely icy. Furthermore, the use of precipitator dust appeared to be limited to areas around the plant entrance and parking areas.

Lead-210 is not considered a COC on any road segment built after 1993, because the practice of using precipitator was ceased in 1993.

Table 6-1 - Constituents of Concern in each Remediation Unit

RU No.	RU Name	Parameters									Information Basis
		P4	Ra-226[a]	Arsenic	Cadmium	Solvents[b]	Liquid Petroleum Fuels[c]	PCBs	Lead-210[d]	Other	
RU 1	Furnace Building	COC	COC	COPC	COPC						P4 encountered under foundation of furnace building during slag ladling conversion project (No. 3 furnace P4 sump). Occurrence within other areas anticipated based on process knowledge and spill assessments.
RU 2	Slag Pit	COC	COC	COPC	COPC						Process knowledge
RU 3	Receiving Stores, Paint Shop, and P4 Decon	COC	COC								Process knowledge, EMF RI
RU 4	Office Buildings and Training Center		COC								EMF RI
RU 5	Lab and Old Drainfield		COC			COC					EMF RI
RU 6	Former Long-Term P4 Storage	COC	COC						COPC		EMF RI and post-RI spill history.
RU 7	Shale Unload, Crushing and Stockpile		COC	COC					COPC		Process knowledge, EMF RI
RU 8	Former Kiln Scrubber Ponds and Calciners		COC		COC				COPC		Process knowledge, EMF RI
RU 9	Silica Stockpiles and Former Kiln Scrubber Overflow Pond		COC		COC				COC		EMF RI
RU 10	IWW Pond and Ditch	COPC	COC						COPC		EMF RI and post-RI spill history.
RU 11	Equipment Area South of Calciners		COC						COPC		Process knowledge, EMF RI
RU 12	Former RP&S Area and Mobile Shop	COC	COC	COC	COC		COPC	COPC	COPC		EMF RI, post-RI spill history, LDR pre-construction soil sampling.
RU 13	Pond 8S Recovery Process & Metal Scrap Preparation Area	COC	COC	COC	COC				COPC		Process knowledge, EMF RI
RU 15	Oversize Ore, Used Electrode, Baghouse Dust Area		COC	COC	COC				COPC		Process knowledge, EMF RI
RU 16	Calciner Solids Stockpile		COC		COC				COC		EMF RI
RU 17	Recyclable Material Landfill								COPC	See Table 6-3, landfill contents	Process knowledge.
RU 18	Plant Landfill					COC	COC		COPC	See Table 6-3, landfill contents	Process knowledge.
RU 19	Slag Pile, Bull Rock Pile	COC	COC	COC		COC	COC		COPC	See Table 6-3, landfill contents	EMF RI, process knowledge, historic aerial photo review.
RU 20	Former Bannock Paving Area		COC			COPC	COPC				EMF RI and post-RI spill history.
RU 21	Other Onsite Railspurs		COC								EMF RI
RU 22b	Old Ponds	COC		COC	COC				COC		EMF RI
RU 22c	Railroad Swale	COC									EMF RI and post-RI spill history.
RU 23	Road segments not within RU Boundaries		COC						COPC		Process knowledge, EMF RI

COC - Constituent of Concern. Evidence of presence in a specific RU based on EMF RI data, process knowledge, post-RI spill history, or other line of evidence

COPC - Constituent of Potential Concern. Potential presence, not confirmed

[a] Gamma radiation measurements will be used as a surrogate to quantify primary risks associated with Ra-226 (ie, external gamma exposure) in RU's where a cap/cover is not envisioned

[b] Includes TCE, PCE, Chloroform, 2-Butanone, and 1,1,1 TCA

[c] Includes benzene, toluene, ethylbenzene, and xylenes

[d] Lead-210 and Polonium-210 are known to occur in precipitator dust and phossy solids. XRF methodology outlined in Appendix H will be used for characterization.

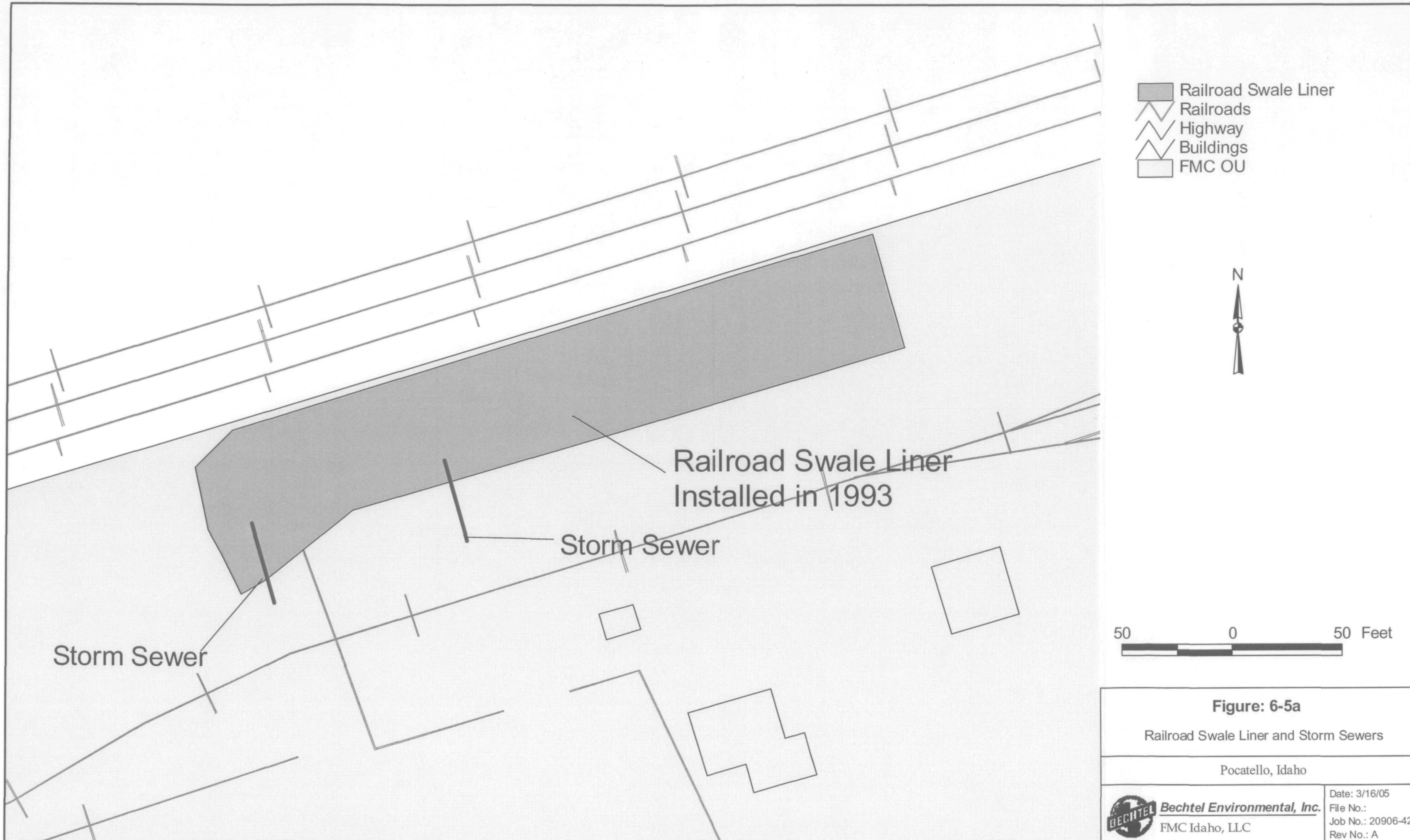


Figure: 6-5a

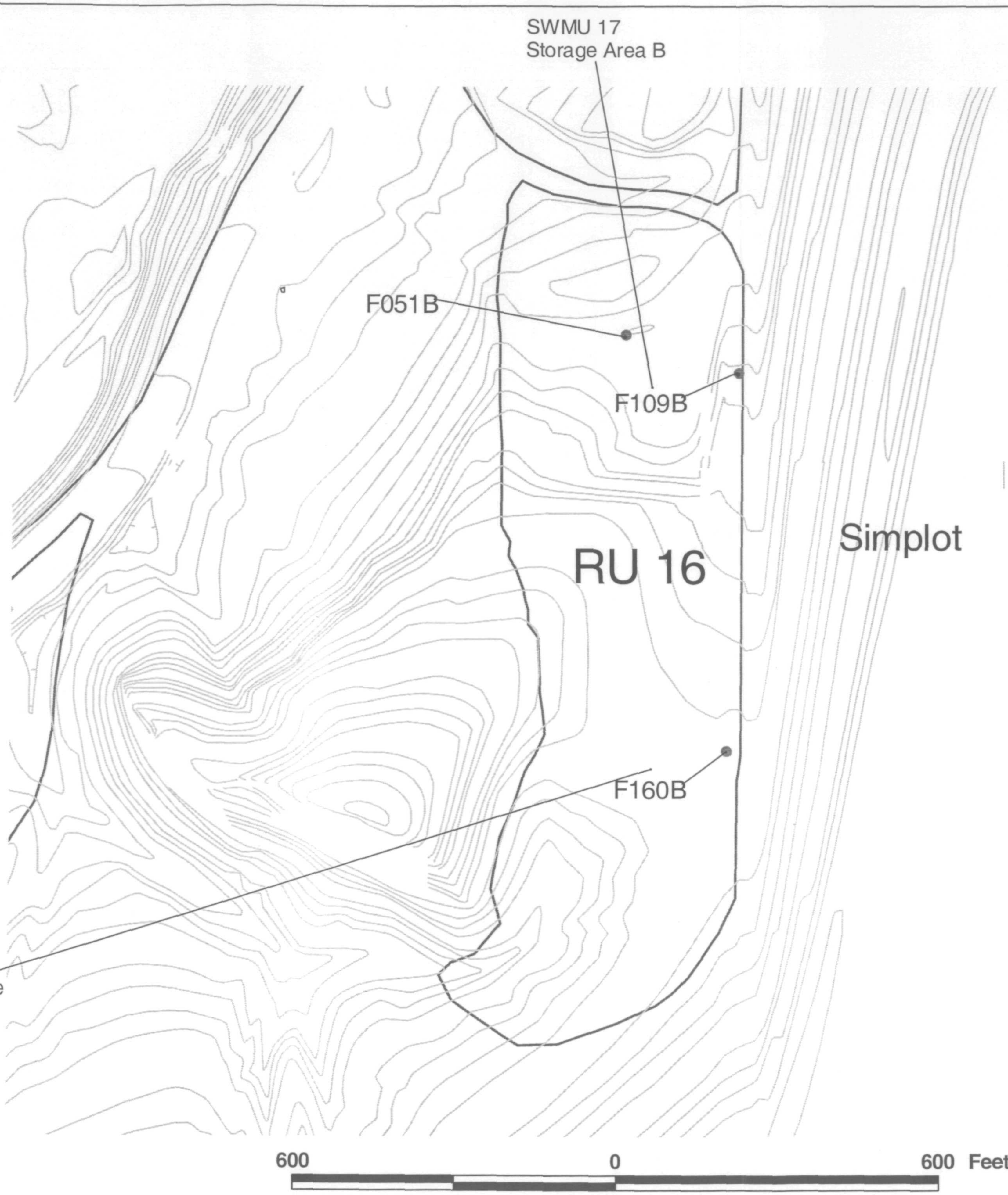
Railroad Swale Liner and Storm Sewers

Pocatello, Idaho

Bechtel Environmental, Inc.
FMC Idaho, LLC

Date: 3/16/05
File No.:
Job No.: 20906-421
Rev No.: A

Document



Not Specified on Map:
SWMU #38: Roads

- Soil borings
- Buildings
- 2ft_contours
- RU Boundaries

Note: No soil samples were collected from boring F160B.

Bechtel Environmental, Inc. SAN FRANCISCO		
FMC IDAHO LLC POCATELLO, IDAHO		
RU 16 Map		
Job Number	Drawing No.	Rev.
20906	Figure 6-10	

▲ Potential source
● Soil borings
RU Boundaries

N

250 0 250 Feet

Figure: 6-10a

RU 16 2003 Air Photo

Pocatello, Idaho

Bechtel Environmental, Inc.
FMC Idaho, LLC

Date: 3/16/05
File No.:
Job No.: 20906-421
Rev No.: A

Document

RU 6 Summary	
RU Description	FMC installed 12 underground steel storage tanks for additional storage of P4. The tanks were two sizes, 104,000 gallons and 52,000 gallons. Tanks were filled by transporting P4 in railcars from the Phos Dock, so there is no underground P4 piping leading to RU 6. Pumps in the tanks were used to load the P4 onto railcars when the P4 was sold. The RU is located on a fairly level area of the FMC plant, and it is bounded by roads on the south and east, and a railroad spur line along the northeast. No underground process pipelines are near or within the RU boundaries.
EMF ROD Remedy	The 1998 ROD selected site-wide institutional controls to prohibit residential use and prevent ingestion of groundwater exceeding MCLs/RBCs. The ROD also selected site-wide institutional controls requiring future structures be constructed with radon control measures.
EMF RI Findings	P4 was not encountered in either of the soil borings drilled in RU 6. Some inorganics were detected at above-representative levels. Maximum depth investigated was 7 feet. Borings did not encounter slag, ore, or precipitator dust.
RI Update: Current status; post EMF RI data; additional sources; COPCs	In 1994, FMC removed eight tanks and backfilled the excavation. In 1998, the last four tanks were removed. During both phases of tank closure, FMC collected samples from the native soils within the excavation to confirm that all soil and tank backfill containing P4 was removed during closure.
Remediation Vision	No action anticipated to be necessary.
Do existing data support remediation vision in context of updated CSM?	No. See Data Gaps below.
Data Gaps	Insufficient data to characterize inorganics in the 0-10' depth interval. Confirmation sampling at railcar loading/unloading area for P4 Confirmation sampling around tank pit for P4 Gamma radiation measurements to characterize slag fill.
CONCLUSION: Forward to SRI for P4 confirmation sampling, gamma radiation measurements, and characterization of inorganics, lead-210 and polonium-210 in 0' to 10' depths. Note: Lead-210 and polonium-210 are radionuclides associated with phossy solids. Phossy solids may be detectable through the use of surrogates, as described in Appendix H.	

Figure 6-14

RU 6 Summary

RU 15 Summary	
RU Description	RU 15 is located south of the calciner ponds, in the Bannock Range area. It is south of the main plant area, and east of the slag pile, near the FMC property boundary with Simplot. It contains mounds of reject ore (similar to the bull rock pile in RU 19), and baghouse dust. The dust originated from raw material handling, such as ore and coke unloading from rail cars. There are some smaller pieces of used or broken carbon electrodes. Larger pieces of carbon electrodes have been sold.
EMF ROD Remedy	The 1998 ROD selected site-wide institutional controls to prohibit residential use and prevent ingestion of groundwater exceeding MCLs/RBCs. The ROD also selected site-wide institutional controls requiring future structures be constructed with radon control measures.
EMF RI Findings	The EMF RI identified EMF-related constituents in the shallow native soils immediately underlying the ore. There was no evidence that these constituents were migrating to groundwater. Ore contains cadmium, chromium, vanadium and zinc at concentrations above background soils, as well as fluoride and phosphorus.
RI Update: Current status; post EMF RI data; additional sources; COPCs	The larger pieces of carbon electrodes have been sold and were removed from the site, after confirmation sampling of the electrodes was performed. RU 15 no longer receives ore, baghouse dust, and other materials for disposal/storage.
Remediation Vision	Consolidate material into minimal footprint, grade to design subgrade elevation and construct soil cover (cap) over area.
Do existing data support remediation vision in context of updated CSM?	No. Leachability testing of the various materials stored in RU 15 is needed to support cover\cap design.
Data Gaps	None.
CONCLUSION: Forward RU 15 to SRI	

Figure 6-39

RU 15 Summary

APPENDIX D
INSERT PAGES

APPENDIX D

GEOTECHNICAL LABORATORY RESULTS FROM COVER/CAP BORROW AREA

FMC IDAHO LLC

NOTE: These laboratory reports and the results/data contained therein are provided for information only. Approval of the RI Update Memo does not constitute approval to FMC or others as to the suitability of the tested materials/soils for use in landfill caps or covers.

APPENDIX E
SWAP PAGES

APPENDIX E

REVISED TECHNICAL REVIEW COMMENTS ON THE JUNE 2004 REMEDIAL INVESTIGATION UPDATE MEMORANDUM FOR THE FMC PLANT OPERABLE UNIT FOR FMC IDAHO LLC IN POCATELLO, IDAHO

RESPONSE TO COMMENTS
FMC IDAHO LLC

Appendix E
Response to Comments

Part 1. Response to General Comments

General Comment #1

The RI Update Memorandum (RI Update Memo) must be revised to include an acronym list.

FMC Response:

The RI Update Memo has been revised to include an acronym list.

General Comment #2

The phrase "above representative levels" is commonly used in the document. It is unclear if this is referring to background concentrations or some other criteria developed during the Eastern Michaud Flats (EMF) Remedial Investigation (RI). The RI Update Memo must explain what the phrase means and how these levels were derived.

FMC Response:

A description of representative levels and the reference to their derivation has been added to the introduction to Section 6 of the December 2004 RI Update Memo.

The term "representative levels" was used during the EMF RI to acknowledge the fact that there are anthropogenic effects in environmental media (soil, air, surface water, sediment, and groundwater) that are not associated with EMF Site activities.

Representative (background) values were derived by EPA during the course of the EMF RI and were used in the EMF RI Report and in EPA's Human Health Risk Assessment (HHRA) (E&E, 1996) to evaluate site-related impacts. An explanation of how these values were derived can be found in Section 2 of the HHRA.

General Comment #3

The RI Update Memo must be revised to include radionuclides known to be present at the site, including: uranium-238, radium-226, polonium-210, lead-210, potassium-40, as well as gross alpha and gross beta activities. The 1996 RI determined that radionuclides present the largest potential threat to future site workers. However, little data has been collected to date that characterizes the extent of radionuclide contamination within the facility.

Radiation Risk Assessment At CERCLA Sites: Q & A (Luftig & Page, 1999) provides a concise summary of the necessary steps to prepare a CERCLA Risk Assessment on sites with radioactive contaminants including identification and measurement of all radionuclides of concern in environmental media. The initial COPC list must include all radionuclides and decay products based on site history, production methods, and characteristics of the ores. In addition, cancer risks should be evaluated using the most recent isotope-specific cancer slope factors (U.S. Environmental Protection Agency Office of Radiation and Indoor Air, 1999; 2002g).

FMC Response:

Please see response to General Comment #4, and Specific Comments #29, 30 and 31 below.

General Comment #4

The June 2004 RI Update Memo does not identify radionuclide risk based concentrations (RBC), areas where radionuclides are present, or present data gaps related to RBCs. The RI Update Memo must be amended to include the investigation and evaluation of radionuclides.

FMC Response to Comment #3 and #4:

FMC believes there are no data gaps with respect to the ***nature*** of radiological impacts within the FMC Plant OU. Rather, FMC believes that the ***extent*** of radiological impact warrants further characterization for those portions of the FMC Plant OU where no further action is proposed in FMC's remedial action vision (e.g., RU 20), and has identified the need to further characterize the extent of radiological impact as a data gap in the RI Update Memo. As discussed during the September 15, 2004 teleconference between FMC, EPA Region 10, IDEQ and the Shoshone-Bannock Tribes, and documented in Appendices F and G of the December 2004 RI Update Memo, FMC proposes to characterize the extent of potential radiological impacts within these areas in the following two ways:

1. Measuring gamma radiation: The greatest contribution to incremental cancer risks (ICR) associated with worker exposure to all feedstocks and waste streams historically processed at the FMC Plant OU (except phossy wastes) is from external gamma radiation. Risk determinations based on direct gamma measurements are more certain than those calculated from radionuclide activities. Therefore, gamma radiation dose rate measurements will be made in the SRI to provide a direct evaluation of risk associated with external gamma exposure at each RU. The SRI Work Plan will identify sampling locations and analytical protocols for the gamma radiation dose rate measurements.
2. Characterizing lead-210 and polonium-210 activities, in addition to measuring gamma dose rates, in areas containing phossy waste (including precipitator dust): Lead-210 and polonium-210 have been determined to be significant contributors to risk associated with exposure to phossy waste, via pathways other than external gamma radiation. Samples for analysis of lead-210 and polonium-210 will be taken at any gamma radiation dose measurement site at which the potential presence of phossy solids is indicated based on visual characteristics and/or XRF analyses. The lead-210 and polonium-210 data will be used, in conjunction with the gamma dose rate measurements, to evaluate potential risks. The approach to be used to identify the potential presence of phossy waste is described in Appendix H of the December 2004 RI Update Memo. This approach, along with the analytical protocols for Pb-210 and Po-210 speciation, will be comprehensively described in the SRI Workplan.

Additional information on gamma radiation, Pb-210 and Po-210 characterization is provided in FMC's response to Comments #29, #30, and #31.

The EMF RI Report characterizes the nature of radiological constituents in potential source materials, soils, and groundwater within the FMC Plant OU. Other sources of data characterizing the nature of radionuclides at the FMC Plant OU include *Radiological Surveys of Idaho Phosphate Ore Processing – The Thermal Process Plan* (EPA, November 1977). Beginning on page 54, this EPA document describes partitioning of radionuclides in the uranium-238 and thorium-232 decay series present in industrial feedstocks among byproducts and waste streams (including air) during ore processing.

Also, the EMF RI Report presented an extensive emission characterization and atmospheric dispersion modeling study, as well as the results of an extensive air quality-monitoring program. Emission inventories were presented for uranium-238, uranium-234, uranium-235, thorium-232, thorium-230, radium-228, radium-226, lead-210, and polonium-210 in point (i.e., stack), area (i.e., stockpile, material handling), and line (i.e., road) sources. Radionuclide activities were also analyzed on PM10 high-vol 24-hour filters collected at seven monitoring stations between October 1993 through March 1994, when routine radiological analysis of filters was discontinued with EPA concurrence.

Available radiological data, which typically includes the activities of uranium-238, radium-226, polonium-210, lead-210, and potassium-40 in potential source materials (feedstocks, byproducts, and waste materials), were documented in the conference notes for the September 15, 2004 teleconference, and have been incorporated into Section 3 of the December 2004 RI Update Memo.

EPA's 1997 HHRA identified exposure to external gamma radiation as the primary factor for the incremental cancer risk (ICR) associated with all radionuclides in surficial materials at the FMC Subarea. A more in-depth analysis has shown that, with the exception of phossy wastes (including precipitator slurry), over 95% of the total ICR for all FMC waste materials, ore, co-products and byproducts that pose a risk greater than background is associated with exposure to external gamma radiation. This information, which was discussed during the August 3, 2004 Agency Coordination Meeting and during the September 15, 2004 Agency Coordination Teleconference, has been incorporated into Appendix F of the RI Update Memo.

Radionuclide speciation was not identified as a data gap in areas proposed to be capped for the following reasons:

- The 1998-ROD selected capping/covering the old phossy pond areas where precipitator slurry and phossy water solids were historically managed. EPA selected this remedy as meeting the RAOs for radiological risk management as well as other RAOs.

- Capping additional areas of the FMC Plant OU (e.g., Slag Pile – RU 19), as stated in the RI Update Memo, will meet the radiological risk management RAO specified for the FMC OU in the EMF ROD.

General Comment #5

Additional data must be collected for the undeveloped southern and western portions of the facility. Fluoride samples collected south of the facility property during the RI indicate that EMF contaminants have been deposited on vegetation exceeding the State of Idaho Rule 58.01.01.06 for total fluoride content in vegetation used for forage. Samples collected southwest of the facility property in the vicinity of Residential Area #8 have shown elevated levels of EMF related contaminants. These data suggest that the undeveloped southern and western portions of the facility may be affected by contaminants resulting from air deposition related to facility operations. The RI Update Memo must include this area as a remediation unit and identify soil concentrations for contaminants of concern as a data gap.

FMC Response:

Existing off-site RI data have proven sufficient to both evaluate ecological risks and to conclude that there is no potential for adverse health effects to future workers within the undeveloped western and southern areas of the FMC Plant OU. Therefore, FMC does not agree that the absence of data from these areas constitutes a data gap, and FMC believes that there is no basis to revise the RI Update Memo to identify the western and southern areas of the FMC Plant OU as a remediation unit.

The Statement of Work (SOW) provides that data associated with the off-site Bannock Hills SW ecological RI sampling station, along with off-site RI surface soil samples collected adjacent to the undeveloped areas of the FMC Plant OU are appropriate to screen on-site ecological risks. The screening assessment performed using the adjacent off-site RI data points was presented in Section 5 of the June 2004 RI Update Memorandum. This conservative assessment of risks in the ERA of the undeveloped portions of the FMC Plant OU determined that no population or community level effects are likely. Furthermore, in the Agencies' specific comments on Section 5 of the June 2004 RI Update Memorandum, no request was made for sampling of the undeveloped western and southern areas of the FMC Plant OU to further support the findings of the ecological assessment. Thus, there are no data gaps with respect to potential ecological impacts in these undeveloped areas of the FMC Plant OU.

As shown in Table 1, the same off-site RI surface soil samples used in the ecological assessment all contain COPC concentrations that are below background and/or commercial/industrial worker SSLs. Thus, it is reasonable to conclude that historical facility emissions have not resulted in surface soil contamination that would pose an unacceptable incremental risk above background to potential future commercial/industrial workers. Moreover, sub-surface soils within the western and southern undeveloped areas of the FMC Plant OU consist of non-impacted native soils, with no potential for adverse health effects to workers above those associated with background exposure. Therefore, further comparison of sub-surface soil concentrations to construction and utility worker SSLs is not warranted. Thus, there is no data gap with respect to evaluating potential worker risks in the western and southern undeveloped areas of the FMC Plant OU.

With respect to fluoride levels in vegetation sampled to the south of the FMC Plant OU exceeding the State of Idaho Rule 58.01.01.06 for total fluoride content in vegetation used for forage, these impacts are not related to activities at the FMC Plant OU. Simplot was the largest source of airborne fluoride emissions (contributing over 90% of the total) during the time of the RI, the period during which the referenced vegetation samples were obtained. Moreover, while the FMC facility ceased operations in December 2001, the Simplot facility is an ongoing source of fluoride emissions. Therefore, any exceedance of the total fluoride forage limits defined in the State of Idaho Rule 58.01.01.06 within vegetation present on the FMC Plant OU is related to ongoing Simplot emissions, an issue that would more appropriately addressed to Simplot representatives.

Table 1
Comparison of RI Surface Soil Data Collected Adjacent to the Undeveloped Western and Southern Areas of the FMC Plant OU to Commercial/Industrial Worker SSLs and Background Levels

COPC	Greater of Commercial/Industrial Worker SSL and Background (mg/kg)	Soil Concentrations at Adjacent RI Sampling Stations (mg/kg)				
		270-2B	248-3B	225-2A	225-2B	180-2B
Antimony	4.54E+02	7.80E+00 UJ	1.18E+01 J	8.10E+00 U	2.66E+01 J	3.90E+00 UJ
Arsenic	7.70E+00	4.10E+00	3.60E+00	4.50E+00 J	5.40E+00 J	5.10E-01 UJ
Barium	6.76E+04	1.71E+02 J	9.74E+01	1.42E+02	1.36E+02	1.78E+02 J
Beryllium	1.06E+03	8.50E-01	5.90E-01	5.60E-01	8.40E-01	9.10E-01 U
Boron	1.02E+05	1.83E+01	4.70E+00	4.30E+00 J	2.00E+00 J	4.16E+00
Cadmium	8.94E+02	1.30E+00	3.80E+00	2.62E+01 J	2.81E+01 J	2.90E+00
Chromium	1.70E+06	2.19E+01	2.20E+01	7.95E+01 J	8.77E+01 J	1.43E+01
Cobalt	9.08E+02	6.90E+00	4.70E+00	5.90E+00	5.00E+00	5.20E+00 U
Copper	4.20E+04	1.71E+01	9.70E+00	1.77E+01	1.62E+01	1.47E+01
Fluoride	6.81E+04	5.30E+02	4.63E+02	1.59E+03	1.68E+03	4.33E+02
Lead	8.00E+02	1.07E+01	1.75E+01 J	1.65E+01 J	1.97E+01 J	2.11E+01 J
Lithium	2.27E+04	1.85E+01	1.03E+01 J	8.70E+00	8.70E+00	1.73E+01
Manganese	3.53E+04	4.68E+02 J	3.50E+02 J	4.65E+02	4.72E+02	6.82E+02
Mercury	3.40E+02	6.00E-02 U	8.00E-02	5.00E-02 U	5.00E-02 U	9.00E-02 U
Molybdenum	5.68E+03	1.30E+00 U	1.10E+00 U	4.40E+00 U	8.40E+00 U	1.10E+00 U
Nickel	1.06E+04	1.55E+01	1.05E+01	2 00E+01	2.04E+01	8.40E+00 U
Selenium	5.68E+03	5.90E-01 UJ	4.40E-01	1.10E+00 J	1.30E+00 J	2.60E-01 U
Silver	5.68E+03	4.10E-01 U	9.20E-01	2.30E+00	2.30E+00	3.30E-01 J
Thallium	7.72E+01	1.22E+01 U	1.30E-01 J	1.20E-01 J	1.10E-01 J	1.00E-01 UJ
Vanadium	7.95E+03	3.15E+01	3.55E+01	9.58E+01	9.17E+01	2.61E+01
Zinc	3.41E+05	7.99E+01	6.19E+01	2.04E+02 J	2.09E+02 J	7.58E+01

- = No Data.
J = Estimated concentration.
U = Non-detect

General Comment #6

Specific design criteria must be proposed for cap design. It is expected that varying levels of elemental phosphorus (P4), inorganics, and radionuclides, in addition to waste volumes, will have a significant effect on the type of cap for each unit. Since capping has been proposed for a number of areas, characterization to assist with the design must be proposed. Specifically, for areas where levels of elemental phosphorus are encountered at levels which burn a cap similar to the cap at pond 8S would be required, for areas where levels of elemental phosphorus are encountered but do not burn, a cap similar to the cap at pond 9E may be more applicable.

FMC Response:

Specific design criteria for cap design (in effect, Remedial Action Objectives) will be developed during the Supplemental Feasibility Study, rather than in the RI Update Memo. This approach conforms with the AOC and SOW for the SRI/SFS. FMC believes that the issue inherent to EPA's comment is whether additional data are needed to develop and/or evaluate cap design(s) for specific RUs. FMC believes that only limited additional data are needed to evaluate remedial designs for RUs that warrant remediation. The December 2004 RI Update Memo identifies the following data gaps that will be addressed during the SRI to provide data for cap design during the SFS:

- o Leachability testing of calciner solids (RU 16) to support designing a cover that sufficiently minimizes infiltration;
- o 44°C isotherm modeling study and confirmatory soil sampling at RU 1 and RU 2 to ensure that the area to be capped has been adequately identified; and,
- o Radon flux measurements from the former phossy waste ponds will be obtained for evaluation of the pond covers relative to the UMTRCA guideline of 20 pCi/m^{2}s.

The remainder of this response provides FMC's rationale for limiting the data gaps to those listed above. The following information is presented for information only, and will be more fully developed in the SFS.

The design of the RCRA pond caps was based first on meeting four primary performance criteria and then took into consideration the volume, moisture content, and P4 level of the sediments to develop a design based on the longevity of the cap deemed appropriate to minimize infiltration and isolate the wastes from direct contact. The primary cap design criteria (RAOs) were developed in the FS Report (1997). The four primary design criteria (or remedial action objectives) for these RCRA closures were:

- Long-term minimization of the migration of liquids through the closed impoundment;
- Function with minimum maintenance;
- Promote drainage and minimize erosion or abrasion of the cover; and
- Install a cap with a permeability less than or equal to the permeability of any pond liner or natural subsoils.

Closure of Pond 8S began in 1994 with the concurrent placement of an initial sand and slag fill and drawdown of the free liquids overlying the phossy waste sediments within the pond. The closure plan called for installing a final cover over the initial fill after the settlement rate of the pond sediments and backfill was reduced to design objectives. The initial design for the final cover at RCRA Pond 8S was a 3.5-foot thick multi-layer cap, based on the design recommended in EPA guidance. FMC believed that the combination of initial fill and a multi-layer RCRA cap collectively met RCRA design criteria for pond closure.

Based on FMC's experience and published research, elemental phosphorus (P4) within the pond solids mixed with water, including nearly saturated conditions after removal of free water and placement of the cap, would remain in the covered sediments for some time. EPA was concerned that the synthetic components in the multi-layer cap could not be demonstrated to have sufficient longevity to meet the performance standards over an extended period. Based on EPA's concern, FMC proposed integration of a capillary-barrier cover above the synthetic layers of the originally proposed 3.5-foot multi-layer cap. The capillary barrier was designed exclusively with natural earthen materials to minimize infiltration, withstand erosive forces over an extended period, and ensure that the cap meets the performance standards over the long-term, independent of the longevity of the synthetic layers. In addition, a biointrusion layer (an 18–inch thick layer of coarse slag) was incorporated into the capillary barrier cap to further minimize the potential for intrusion.

The final caps at RCRA Pond 9E and RCRA Pond 8E are similar to the initially proposed Pond 8S final cap with the understanding that the sediments within these ponds did not warrant the added degree of protection afforded by the longer-term design life of the Pond 8S-type cap, because P4 levels remaining in these sediments were much lower. For example, in the case of Pond 9E, the pond had been dredged to remove pond sediments and free liquids to the extent feasible and then the sediments were actively turned to further dry the sediments so the pond could be converted into a drying pad for NOSAP treated precipitator slurry. Although the conversion was not completed, the pond sediments had been dried and oxidized extensively for several years before the initiation of closure. Pond 8E, on the other hand, contained free liquids and saturated phossy wastes, but the waste had been treated by the NOSAP process, which consistently reduced P4 levels in precipitator slurry to below 1,000 ppm (the level determined by FMC where phossy waste sediments were not observed to ignite or smoke).

The following sections review those design criteria and provide a description of additional considerations and criteria that were evaluated for identification of potential SRI data gaps.

(1) Inorganics and Radionuclides as Cap Design Factors

In the FS Report and the ROD, FMC and EPA clearly identified inorganic chemical and radiological constituent levels of the residual sediments in the former phossy waste ponds as cover design factors.

As described in the RI Update Memo, the 1998 ROD specifically identified the old phossy ponds area (RU 22b) as requiring remediation to meet RAOs for preventing external exposure to radionuclides in soils and direct exposure (ingestion/inhalation) to COCs above the stated carcinogenic and non-carcinogenic risks. At Section 10.2.2 of the ROD, EPA specified that, in addition to backfill and grading to prevent ponding and enhance surface drainage, a surface cover of at least 12 inches will be installed at the old phossy ponds. Prior to the ROD, EPA requested that FMC perform an evaluation of the 12-inch soil cover described in the FS Report with respect to shielding gamma emissions from radionuclides in pond solids and/or slag. FMC performed the evaluation and found that a 12-inch layer of soil would shield gamma emissions from the underlying material such that measured gamma exposure at the surface of the soil layer would be essentially equivalent to the gamma emissions for the soil itself (i.e., soil background emissions.)

Radium-226 activity of potential source materials and soils is the primary contributor to radiological risks. Radium-226 decay products generate gamma radiation. As discussed in FMC's response to Specific Comment 31 and elsewhere, FMC has proposed to measure gamma radiation levels at areas where the need for remedial action has not already been identified. Soil covers or other mitigation measures will be evaluated in the SFS for areas exhibiting gamma radiation at levels that pose a risk to future site workers. Standard radiation shielding models such as Microshield™ can be used to evaluate cover designs, with the radium-226 activity of the source material being input to characterize the strength of the gamma radiation to be controlled. FMC believes that sufficient data are available to correlate measured gamma radiation levels with radium-226 activities, and that additional radium-226 characterization data are not needed to support potential radiation modeling studies during the FS.

FMC also believes that radon flux from residual sediments should be considered in developing cover design criteria. As noted previously in this response, radon flux measurements from the former phossy waste ponds will be obtained during the SRI for input to cap design to ensure that radon flux from the cap will be below the UMTRCA guideline of 20 pCi/m^2s.

(2) Elemental Phosphorus Level as a Cap Design Factor

FMC would like to clarify that, although the concentration of elemental phosphorus in pond sediments was a design consideration, elemental phosphorus concentration was not warranted as a primary cap design criterion.

The nature of the residual pond sediments in the old phossy waste ponds within RU 22b is significantly different from the nature of phossy wastes in RCRA Pond 8S at the time of its closure. Phossy wastes were periodically reclaimed from the RU 22b ponds, and the residual sediments lack free liquids that would maintain the phossy wastes in an unoxidized condition. The residual sediments in many ponds have been covered with slag or lie beneath lined RCRA ponds (now closed). In many of the old ponds, the minimal residual volume and dried condition of the solids strongly suggests that the majority of P4 has oxidized to below the 1,000 ppm smoking level.

Specification of either a Pond 8S-type "double cap" or a Pond 9E cap as a design criterion for these former unlined phossy ponds in RU 22b at this time is inappropriate due to the nature (volume, moisture content, and P4 level) of the residual phossy wastes present within these former ponds. Rather, a capillary barrier cap without an underlying synthetic layer may be an appropriate remedial design that ensures that the remedy meets the RAOs. Specific cap designs will be evaluated in the SFS.

(3) Nature of Residual Sediments and P4 in Former Phossy Waste Ponds in RU 22b.

Table G6 provides information on each former phossy waste pond within Remediation Unit 22b. This information includes a summary of pond history from Appendix M of the EMF RI Report, estimated volume of remaining pond sediments, observations on pond sediment properties and P4 occurrence where soil borings or groundwater well borings were advanced within the footprint of the former pond during the EMF RI, and the oxidation/reduction (Eh) potential in groundwater upgradient and downgradient from ponds where wells are closely positioned to detect the residual influence from leakage from the old ponds.

As noted in Table G6:

- Materials were periodically removed from the ponds and P4 was reclaimed from these materials. This material was blended with the ore, processed at either the kiln or calciners, and sent to the furnaces. Additionally, at various times the dried wastes were reclaimed and sold. This history of reclamation of phossy wastes from these former unlined phossy waste ponds is in contrast to the more recent operation of lined RCRA phossy waste ponds, from which phossy wastes have not been reclaimed.

- Soil and well borings demonstrate the absence of P4 over large areas of the old ponds. Of the 31 soil and well borings advanced within the footprint of former unlined phossy waste ponds, all but one (F037B) encountered slag fill over a 1 to 4-foot thick layer of oxidized pond solids (slightly moist or dry) or slag fill over native soils (suggesting that phossy solids had been removed or had not accumulated). F037B was advanced through 20 feet of slag fill before encountering elemental phosphorus at 23.5 feet bgs.

- Soil and well borings also demonstrate the absence of free liquids within the residual sediments. Former unlined phossy pond sediments have been either exposed or covered with slag (slag is permeable) for decades, except where the former pond is overlain by a newer, lined RCRA phossy waste management pond. Exposed or slag covered phossy wastes would not be expected to contain free liquids and the majority of P4 would have been oxidized to below the 1,000 ppm smoking level.

- Groundwater monitoring data obtained over more than the last 10 years shows that oxidizing conditions (higher Eh levels) are encountered in wells within and downgradient from the former unlined phossy waste ponds (RU 22b). For example, samples from Well Pair 133/134, downgradient from the former unlined phossy waste ponds, consistently exhibit positive Eh values. Reducing conditions (strongly negative Eh levels) are encountered only in wells 150, 152, 155, 156 and 157 downgradient from Pond 8S.

In summary, about half of the old phossy ponds have little or no remaining pond sediments, none of the ponds contain free water or even saturated sediments, and P4 levels in residual pond sediments are estimated to be below 1,000 ppm in all of the seven "E-series" ponds, as well as in six of the eleven "S-series" ponds within RU 22b.

See Table G6.

Table G6: OLD PHOSSY WASTE POND INFORMATION

Pond	Material Received/History (from Appendix M of EMF RI Report and RI Update Memo)	Area (acres)	Est. Volume (yd3)	EMF RI soil and GW well borings within pond footprint	Were phossy pond solids encountered in boring/drilling?	Was P4 evidenced during boring/drilling?	Estimated P4 level	Is old pond overlain by a newer, capped RCRA pond?	Closely-spaced GW well Up = upgradient Dn = downgradient	Eh difference in upgradient and downgradient wells
00S	Phossy water and phossy solids. Former unlined pond. Pond location inaccessible; not an engineered structure, dimensions not available; no release controls known. Pond 00S thought to be beneath Mobile Equipment Shop. Characterization of unit expected to be similar to other former unlined S-series ponds.	0.1	No est. available	F060B	Yes (@ 0' to >2' bgs)	No	<1,000 ppm	No	na	na
0S	Phossy water and phossy solids. Former unlined pond. Not an engineered structure; no release controls known. Characterization of unit expected to be similar to other former unlined S-series ponds.	0.7	No est. available	F061B, F073B, F074B	No	No	<1,000 ppm	No	na	na
1S	Phossy water and phossy solids. Former Pond 1S was completed in about 1956, and had a surface area of only about one-half an acre (21,800 ft2). This pond contained slurry material to a depth of about 11 feet. Some P4 was reclaimed from this former pond between 1966 and 1972. Residuals from the reclaim operation were placed in Pond 3S. Pond 1S was dried and capped in 1972. The area was disturbed during the excavation of a power line trench in 1976, and the contents oxidized. In 1991, this area was estimated to contain about 2,850 tons (2,400 yd3) of phossy waste material.	0.5	2,400	na	na	na	>1,000 ppm (based on reported oxidation when sedimentes were exposed in 1976 trenching)	No	na	na
2S	Phossy water and phossy solids. Former Pond 2S was also completed in about 1956, and had a surface area of about 0.8 acre (34,850 ft2). Depth of slurry material was estimated to be similar to that in Pond 1S, or about 11 feet. Some P4 was reclaimed from this former pond between 1966 and 1972. Residuals from the reclaim operation were placed in Pond 3S. This pond was also dried and capped in 1972. In 1991, this area was estimated to contain about 1,050 tons (875 yd3) of phossy waste material.	0.8	875	B-4, B-5, F037B	Yes (B-4 @ 0' to >7 bgs; B-5 @ 0' to >6 bgs, F037B @ 23' to >24 bgs when drilling ceased)	Yes	>1,000 ppm (encountered P2O5 smoke during drilling)	No	na	na
3S	Precipitator slurry solids, slag pit water and solids, phossy water and phossy solids, residual from P4 reclaim operations. Former Pond 3S was constructed in November 1961. It was used from November 1961 until some time in 1965. It was routinely dug out twice a year during the time it was in operation. Between 1972 and 1976, phosphorus was reclaimed from the eastern 100 feet of this former pond, and the area was backfilled with slag. The rest of the pond area was dried between June and December of 1976, and then covered with dirt and slag. Pond 3S had a surface area of about 1.2 acres (52,300 ft2), and was about 20 feet deep. It is estimated to contain about 10,600 tons (8,800 yd3) of phossy wastes, primarily precipitator slurry.	1.2	8,800	na	na	na	>1,000 ppm	No	W133 (Dn); W134 (Dn)	Oxidizing conditions (W133 = 106 mV; W134 = 90 mV)
4S	Precipitator slurry solids. Pond 4S, located south of Pond 3S, was constructed in April 1966. This pond, with an area of 0.8 acre (34,850 ft2) operated for a period of about one year, receiving precipitator slurry. This pond was estimated to contain about 6.4 feet of slurry, or an estimated 7,800 tons (6,500 yd3) of phossy waste material (precipitator slurry). It was isolated for drying in June of 1976, and covered with dirt and slag in the latter part of the year.	0.8	6,500	na	na	na	>1,000 ppm	No	W159 (Up)	Reducing conditions Eh: W159 = -119
5S	Phossy water and phossy solids. Pond 5S received primarily phossy water and phossy solids, creating a residual waste with a very high phosphorus content. This pond had an area of about one acre (43,560 ft2) and contained residual slurry to a depth of about 6.4 feet. This pond was in operation from 1965 through 1967. Closed and dried in 1975-76, it proved difficult to dry due to the high phosphorus content of the waste. It was covered with baghouse dust, dirt, fluid bed drier prills and dust, slag, and a soil cap over the top. It is estimated that about 10,200 tons (8,500 yd3) of phossy waste material remains in this former pond area.	1	8,500	na	na	No	>1,000 ppm	No	W141 (Dn)	Eh in W141 = -17 mV

Table G6: OLD PHOSSY WASTE POND INFORMATION

Pond	Material Received/History (from Appendix M of EMF RI Report and RI Update Memo)	Area (acres)	Est. Volume (yd3)	EMF RI soil and GW well borings within pond footprint	Were phossy pond solids encountered in boring/drilling?	Was P4 evidenced during boring/drilling?	Estimated P4 level	Is old pond overlain by a newer, capped RCRA pond?	Closely-spaced GW well Up = upgradient Dn = downgradient	Eh difference in upgradient and downgradient wells
6S	Precipitator slurry solids, phossy water and phossy solids. Pond 6S was about twice the size of any of the earlier ponds, with a surface area of about 2.3 acres (100,200 ft2), and a depth of about 4 feet. This pond operated from 1967 through 1969 and received primarily precipitator slurry, with some phossy water and phossy solids. The phossy solids were placed in the northeast corner. This pond was dried in 1976, capped with slag and dirt, and a new haul road was constructed over the south end of the area. It is estimated that about 29,500 tons (24,600 yd3) of phossy waste material remains in this former pond area.	2.3	24,600	F055B, F056B, F057B, F058B, F059B, W156	Yes (F056B @ 7' bgs, F057B @ 7' bgs, F058B @ 9' bgs, F059B @ 10' bgs, W156 @ 15' to 25' bgs)	No	<1,000 ppm	RCRA Pond 8S partiall covers south end	W151 (Up), 156 (within)	Eh in W151 = 18, W156 = -182
7S	Precipitator slurry solids with some phossy solids. Constructed in 1969 and in service for about 18 months, Pond 7S, at 3.6 acres (156,800 ft2), was the largest pond placed in service to that date. This pond received primarily precipitator slurry. When closed in 1980, there were some areas where there were high concentrations of phosphorus. These areas were capped with concrete. The entire area was then capped with 6 to 10 feet of slag and three feet of soil placed over the slag. This area is estimated to contain about 21,800 tons (18,200 yd3) of residual phossy wastes.	3.6	18,200	W155	No	No	>1,000 ppm	No	W159 (Dn)	Reducing conditions Eh in W159 = -119 mV
8S[(4)]	Phossy water and phossy solids, some precipitator slurry solids. Pond 8S was constructed in October 1970 and received phossy water. This pond was also used in a pilot phosphorus recovery project from 1982 through 1990. Pond 8S has a surface area of about 3.1 acres (135,000 ft2) and has about 15 feet of phossy wastes in the bottom. The volume of these wastes is difficult to estimate, as they have not been dried and capped as the other ponds have been. The volume after capping will probably be similar to that of Pond 7S, which is of similar size. The wastes in Pond 8S are high in phosphorus content. Pond 8S has been capped and certified closed under RCRA Interim Status Standards and is in post-closure care.	3.1	90,350	na	na	na	>1,000 ppm	RCRA Pond 8S is capped. Closure has been certified. The unit is in post-closure care.	W150 (Dn), W152 (Dn); B-13 (Dn), W155, W156, W157	Strongly reducing conditions (Eh in downgradient wells approx. -239 mV) W155=6.8, W156=-182, W157=-217
9S	Dried precipitator slurry solids..The four-acre (174,250 ft2) Pond 9S was constructed in 1971 to receive precipitator slurry. The pond operated until about 1974. In October of 1980, the material was dried in place without a cover, and the dried material was excavated and sold during the summer of 1981. This area was used as a storage area for dried precipitator dust between 1981 and July 1991. FMC discontinued the sale of precipitator dust as a product in July 1991. Some small local pockets of precipitator slurry may remain in this area, but in general, the material has been removed and sold.	4	0[(1)]	B-2, F034B	Yes (B-2 @ 2' to 5' bgs)	No	<1,000 ppm	No	W131 (Up); W132 (Dn)	Eh in W131 = 113 mV; W132 = -15 mV
10S	Fluid bed dryer slurry. A former pond for storage of precipitator slurry before processing in the fluidized bed dryer process, which ceased operation in 1986. Remaining precipitation slurry in pond has dried out and crusted over. No precipitation dust has been piled atop the dried pond 1.7 acres; single lined with no leak detection system.	1	8,050	na	na	na	<1,000 ppm	No	W135 (Dn)	Eh in W135 = 86 mV
1E	Phossy water and carryover fine solids from upstream ponds, precipitator slurry solids and dried slurry. Pond 1E was constructed in April of 1965 and had a variety of uses. This 1.9 acre (82,750 ft2) pond was used as a drying pond for various wastes, and for temporary storage of dried precipitator slurry. The pond was dried in October of 1980, but was used again as a temporary storage and loadout site for dried precipitator slurry dredged from ponds 8E and 9E. This area is estimated to contain about 10,800 tons (9,000 yd3) of residual phossy waste materials.	1.9	9,000	B-1, F033B	Yes (B-1 @ 0' to 4' bgs)	No	<1,000 ppm	RCRA Pond 8E covers north portion	W167 (Up)	Data Not Available
2E	Phossy water and carryover fine solids from upstream ponds. Former Pond 2E was a 3.3 acre (143,750 ft2) pond established in April 1965. It received phossy water and carryover fine solids from upstream ponds until October 1967. The site was also used for fluid bed drier product storage. This pond was excavated in 1984 for the construction of lined Pond 8E. The residual slurry materials were moved to nearby Pond 4E.	3.3	0[(1)]	na	na	na	<1,000 ppm	RCRA Pond 8E covers entire area	W103 (Dn); W104 (Dn)	Oxidizing conditions Eh: W103 = 209 mV; W104 = 151 mV

Table G6: OLD PHOSSY WASTE POND INFORMATION

Pond	Material Received/History (from Appendix M of EMF RI Report and RI Update Memo)	Area (acres)	Est. Volume (yd3)	EMF RI soil and GW well borings within pond footprint	Were phossy pond solids encountered in boring/drilling?	Was P4 evidenced during boring/drilling?	Estimated P4 level	Is old pond overlain by a newer, capped RCRA pond?	Closely-spaced GW well Up = upgradient Dn = downgradient	Eh difference in upgradient and downgradient wells
3E	Phossy water and carryover fine solids from upstream ponds. Pond 3E was put into service in May 1967 and received phossy wastes until September 1970. With a surface area of 10.4 acres (453,000 ft2), this was the largest unlined pond constructed at the facility. The pond received phossy water and carryover fine solids from upstream ponds. Some of this material was removed and sold. This pond was excavated for the construction of the lined Phase IV Ponds (11S, 12S, 13S and 14S) in 1980.	10.4	$0^{(1)}$	na	na	na	<1,000 ppm	RCRA Phase IV Ponds cover entire area	W131 (Dn)	Reducing conditions Eh in W131 = -113 mV
4E	Phossy water and carryover fine solids from upstream ponds, precipitator slurry solids overflow. Pond 4E was also put into service in May 1967 and received phossy wastes periodically until 1982. Pond 4E had a surface area of about 1.8 acres (78,400 ft2). The pond received precipitator slurry overflow, residual solids from Pond 2E modifications, carryover fine solids from upstream ponds, and slag-contaminated dried precipitator dust. The site was also used for fluid bed drier product storage. This pond was dried in 1980 and the dried material was sold. As described above, the area was used occasionally for storage of waste materials between 1980 and 1982. This area, adjacent to the southern boundary of the Phase IV ponds (11S-14S), is estimated to contain about 34,850 tons (29,000 yd3) of residual phossy waste materials. The area has not been capped.	1.8	29,000	F024B	No	No	<1,000 ppm	No	na	na
5E	Phossy water and very minor carryover fine solids from upstream ponds. Former Pond 5E was a 6.6 acre (287,500 ft2) pond established in April 1968. This pond received wastes until 1972-1973. The pond received phossy water and minor carryover fine solids from upstream ponds. The pond was dried in October 1980, and 4 to 6 inches of dried gray dirt was removed and placed in the area just south of lined Pond 15S. New pond 15S was constructed in 1982 over former Ponds 5E, 6E, and the eastern portion of Pond 7E.	6.6	$0^{(1)}$	F025B, W114	Yes (W114 @ 0' to 5' bgs)	No	<1,000 ppm	RCRA Pond 15S covers majority of area	W113 (Dn), W114 (Dn) W115 (Dn), W166 (Dn)	Eh: W113 = 72; W114 = -52; W115 = 23; W166 = Data Not Available
6E	Phossy water and very minor carryover fine solids from upstream ponds. Former Pond 6E was a 6.7 acre (291,800 ft2) pond established in November 1968. This pond operated in the same manner as Pond 5E, receiving wastes until 1972-1973. The pond received phossy water and minor carryover fine solids from upstream ponds. The pond was dried in 1981 and as described above, new lined Pond 15S was constructed in 1982 over former Ponds 5E and 6E.	6.7	$0^{(1)}$	F026B, F101B. F101R, W129; W130	Yes (F101R @ 0' to 0.5' bgs)	No	<1,000 ppm	RCRA Pond 15S partially covers area	W129 (Dn); W130 (Dn); W137 (Dn), W165 (Up)	Oxidizing conditions Eh: W129 = 188; W130 = 216; W137 = 191; W165 = Data Not Available
7E	Phossy water overflow from upstream ponds. Pond 7E was a 4.3 acre (187,300 ft2) pond constructed in December 1969. This pond received overflow phossy water from upstream ponds. No solids were observed in this pond. In 1982 Pond 7E was partially excavated and the excavated materials were used in the construction of Pond 15S.	4.3	$0^{(2)}$	F162B, W170, W172, W180, W182	No	No	<1,000 ppm	No	W170 (Dn), W171 (Dn), W172 (Dn), W180 (Dn), W181 (Dn), W182 (Dn)	Data Not Available

(1) Material was removed and placed in another pond,or sold and only thin layer of dried material remained. New ponds were constructed over all or part of the area occupied by this pond.

(2) Pond 7E was an overflow pond. Most of the pond was removed during the construction of Pond 15S.

(3) Area 9S was a former unlined pond that was excavated and used as a storage area for precipitator slurry solids. The volume of dried precipitator slurry solids remaining in the area is shown.

(4) RCRA Waste Management Unit closed under RCRA Interim Status Standards; in RCRA Post-closure Care status. Data included for comparison purposes to illustrate potential influence of unlined S-series pond that recently contained free liquids

General Comment #7

The RI Update Memo should include a discussion regarding how existing groundwater sampling data could be used as part of the focused feasibility study to evaluate the effectiveness of caps that had been installed in areas determined to have been under a sustained hydraulic head. This may have an impact on the groundwater sampling design portion of the supplemental remedial investigation (SRI) and feasibility study.

FMC Response:

Although the data from FMC's on-going groundwater-monitoring program is indicating an improvement in groundwater quality at certain areas of the FMC Plant OU since the EMF Site RI, including downgradient from former unlined Pond 8S, the improvement in groundwater quality is predictable based on elimination of the hydraulic head independent of the type of cap ultimately placed on the pond. The Pond 8S Solute Transport Model (FMC 1993) demonstrated that a substantial period of time will transpire following elimination of sustained head from Pond 8S before the migration of residual COPCs present in deep fine-grained soils above the shallow aquifer diminish to levels at which groundwater quality in the shallow aquifer would reach MCL levels. The cap installed above the wastes has minimal influence on the migration of COPCs from these fine-grained soils into the shallow aquifer, once the major "driving force" (sustained hydraulic head above pond sediments) is removed during the initial phase of pond closure. The primary function of the cap is to act as a barrier to potential exposure to the wastes and prevent/minimize long-term infiltration into the wastes.

Thus, FMC cannot support the proposition that groundwater monitoring and evaluation is a meaningful exercise for the purpose of evaluating cap designs in the SFS as is suggested by the comment. Rather, per the 1998 ROD[1], groundwater monitoring design, evaluations, and conclusions will be developed and performed under the RDRA and post-remedial action monitoring in the context of confirming the effectiveness of implemented remedial actions (i.e., source controls), and, as such, is beyond the scope of the RI Update Memo. No revision of the RI Update Memo is warranted.

General Comment #8

Soil Screening Levels (SSL) were not developed for a number of chemicals of potential concern (COPCs) that have been identified as COPCs for Supplemental RI/FS, including fuel oils, solvents, and polychlorinated biphenyls (PCBs). FMC must develop and present a comprehensive list of SSLs for all identified COPCs in accordance with current EPA guidance.

[1] The EMF ROD states: "Groundwater monitoring will continue and be integrated, to the extent practicable, with the RCRA groundwater monitoring program. EPA will periodically review ground water data with the following goals: (1) insure the source control measures at the old phossy waste ponds, calciner solids, and railroad swale are effective, (2) Insure there are no new sources of contamination from existing or new hazardous waste surface impoundments or landfills, (e.g., Pond 9E, Phase IV Ponds, Pond 15S, Pond 8E and the lined calciner ponds), and (3) confirm eventual achievement of MCLs or RBCs."

FMC Response:

FMC will develop SSLs (RBCs) for PCBs and the organic chemical constituents of fuel oils and solvents that have previously been detected in soil samples obtained from the FMC Plant OU, recognizing that some of these constituents may be within the CERCLA petroleum exclusion. The specific compounds for which SSLs will be developed are: 1,1,1-Trichloroethane, Aroclor 1260, Chloroform, Ethylbenzene, Tetrachloroethene, Toluene, Trichloroethene and Xylenes. These SSLs will serve as a basis for evaluating existing data and to support evaluation of analytical data to be obtained during the supplemental remedial investigation. FMC will provide these SSLs in a subsequent deliverable.

General Comment #9

The text must be revised to include an uncertainty discussion with regards to the development of SSLs for soils. This discussion must include, but not be limited to, uncertainties associated with utilizing site-specific parameters and EPA default parameters to develop SSLs.

FMC Response:

As discussed in greater detail within the response to Specific Comment 42, Section 4 of the December 2004 RI Update Memo has been revised to include a discussion of the uncertainties associated with the assumptions incorporated into the development of soil screening levels (SSLs). This discussion will include, but not be limited to, uncertainties associated with utilizing site-specific and EPA default parameters in the SSL calculations.

General Comment #10

The RI Update Memo must provide a waste characterization based on process knowledge to document the waste characteristics and waste volumes associated with the railcars assumed to be buried beneath the slag pile. The buried rail cars could be a potential source of groundwater contamination. Existing data must be compiled in order to assess groundwater flow direction. If, based on this review, new groundwater monitoring wells are needed they should be installed and sampled for EMF related contaminants for the purpose of monitoring the groundwater beneath the slag pile. Groundwater data gaps must be identified in the RI Update Memo. If new wells are required they must be installed and sampled as part of the SRI.

FMC Response:

The December 2004 RI Update Memo has been revised to include the following discussion on the characterization of plant sludge that was contained in the rail cars:

> "Phosphorus sludge present in the buried railcars is an emulsion of P4, water, and 'dirt.' P4 globules suspended in water will join and form a continuous layer of elemental phosphorus at the bottom of collection sumps and storage tanks. In the presence of high dissolved solids in water, or impurities (i.e., dirt) carried in the furnace gas stream, the P4 globules cannot bind together and form a continuous layer of P4.
>
> Phosphorus sludge formed when the dissolved solids (ions) and suspended dirt "coat" the P4 globules. This coating prevented the coalescing of P4 globules by preventing the globules

from contacting each other. As a result, the globules remained in suspension, forming an emulsion with the water.

Ions and charged dust particles adhere to P4 globules in low pH environments, so sludge formation was more prevalent at pH <3, but would also form at higher pH if there was sufficient dust and ions in the water.

Another factor that influenced sludge occurrence is the rate of cooling in the primary condenser. Faster cooling rates led to smaller P4 globules, which would not coalesce as readily as larger globules.

The sludge buried in the railcars was excess sludge generated in 1962 to 1964 when the FMC furnaces and/or condensers were not operating optimally. There were too many impurities in the process not allowing P4 product to adequately settle out. Instead, a significant quantity of P4 globules was emulsified into sludge. Excess phosphorus sludge was temporarily stored in 30 railroad tank cars, specifically purchased for this storage. After process improvements had been implemented to reprocess phosphorus sludge (e.g., centrifuge) and lower plant sludge production, FMC personnel emptied all 30 railcars to recover P4 product but left the phosphorus sludge in the railcars for expected removal during subsequent railcar cleaning.

After P4 product recovery was completed and the railcars were no longer needed for storage, nine of the 30 railcars were completely cleaned of phosphorus and phosphorus sludge and these cleaned railcars were sold for scrap. However, several "near miss' safety incidents associated with cleaning of these railcars in 1964 resulted in a decision not to attempt to clean but rather to bury the remaining 21 railcars at the south end of the slag pile (per the configuration of the slag pile in 1964). In the late Fall of 1964, the remaining 21 railcars were removed from their trucks, hauled to the slag pile, and buried with clay, then covered by slag. Subsequently, the railcars were further buried under the east slag pile as it advanced south. The location of the buried railcars is currently covered with a minimum of approximately 50 feet and a maximum of over 100 feet of slag.

The location of these buried railcars is documented in an aerial photo taken in June 1965, which shows seventeen identifiable, partially buried railcars. The tank dimensions are 30' in length by 9.5' in diameter. This yields a volume of 1703 cubic feet per rail car. The aggregate volume of all 21 railcars would be 1,325 cubic yards [(21 x 1703) / 27 cubic ft per cubic yd]. Current FMC personnel familiar with phosphorus reprocessing activities believe that the railcars may have contained phosphorus sludge at 50% to 75% of the railcar capacity. Thus, the amount of buried phosphorus sludge may range from 662 cubic yards (if 50% full) to 1,325 cubic yards (if 100% full)."

FMC has conducted groundwater monitoring throughout the FMC Plant OU and RCRA units since 1990. FMC believes that numerous data are available to assess groundwater flow direction associated with the Slag Pile, as noted above. During the past 14 years, wells located downgradient from the slag pile and buried railcars have shown no indication of contamination emanating from this area. Groundwater flow patterns, hydraulic relationships between shallow and deep hydrogeologic units, flow rates, and the nature and extent of contamination have all been characterized and monitored (see Sections 3.3, 4.4, 5 and Appendix K of the EMF RI Report, and "Revisions to RCRA Corrective Action Environmental Indicators" submitted by

FMC to EPA in 2002; and in annual RCRA GW assessment reports submitted since 1993). The 14 years of groundwater monitoring data, coupled with extensive efforts to model and characterize groundwater flow and contaminant transport, indicate no evidence that the buried railcars in the slag pile are a source of contamination to groundwater and there are no data gaps with respect to implementation of the groundwater remedy selected in the 1998 ROD for the FMC OU.

FMC believes that additional characterization of the railcars as a source to groundwater would not alter implementation of the presumptive remedy proposed by FMC.

General Comment #11

Slag Pile Dose Survey. In addition to gross gamma measurements proposed for the slag pile, gross alpha data must also be collected.

FMC Response:

FMC has not revised the RI Update Memo as requested in EPA comment. FMC does not understand how the collection of additional gross alpha measurements of slag or gamma radiation measurements will contribute to remediation design. FMC's remediation vision, as presented in the RI Update Memo, is to cover the Slag Pile to prevent future site workers from exposure to radiation and from potential fugitive dust emissions. The RI Update did not propose to collect additional gross alpha or gamma radiation measurements at the Slag Pile, since existing data already support the proposed remedial action. The gamma radiation measurements made at the Slag Pile were used as input into the MicroShield™ modeling that demonstrated that the 12-inch soil cap design in the 1997 Feasibility Study meets the RAO for controlling gamma radiation exposure.

Part 2. Response to Specific Comments

1. Executive Summary, Page ES-1

Although the 1998 ROD concluded remedial action is necessary for certain units, these remedies were based upon the premise that FMC continued operation of the facility. An evaluation of whether adequate data exists for final remedy design must be included in the RI Update Memorandum.

FMC Response:

The Executive Summary has been revised to note that the assessment of data adequacy reflects the assumption that FMC will not continue to operate the facility. However, this assumption was already embodied in the June 2004 draft of the RI Update Memo. The Conceptual Site Model (Section 2) assumed that the facility property will be reused for a commercial and/or industrial purpose by an entity other than FMC. Data available for each remediation unit were evaluated in Section 6 based on this future land use assumption, and data gaps were identified as input to the scope of the SRI Work Plan.

While the 1998 ROD assumed that FMC would continue to operate the facility, the selected remedies are not restricted by this assumption. Remedies were selected for areas that were not associated with ongoing operations, such as the former phossy waste ponds (designated as RU 22b in the RI Update Memo), and for FMC OU-wide groundwater. Remedies were evaluated at additional areas, such as the slag pile, but were not selected in light of FMC's continued operation of those areas in association with elemental phosphorus production. A notable example is the slag pile (now designated as RU 19), where EPA found that while remediation (i.e., capping) would be appropriate under EPA's default future land use assumptions, FMC's ongoing administrative controls while operating were protective of human health and the environment. The SFS will evaluate methods to ensure that the previously selected remedies, as well as additional remedies at other RUs, are monitored and maintained by FMC in the absence of an on-site industrial manufacturing operations department.

Notwithstanding these observations, FMC believes that the RI Update Memo and the subsequent SRI Work Plan will provide an evaluation of whether adequate data exist for final remedy design. The RI Update Memo identifies two types of data needs: (1) additional site characterization data needed to determine if remedial action is warranted at various RUs, and (2) engineering data needed to develop or refine remedial designs for RU that warrant remediation. Examples of the latter type of data needs are leachability testing of calciner solids (RU 16) to support designing a cover that sufficiently minimizes infiltration, and the 44°C isotherm modeling study and confirmatory soil sampling at RU 1 and RU 2 to ensure that the area to be capped has been conservatively identified.

2. Section 2, Figure 2-10: Conceptual Site Model for Potential Human Exposure to Contaminants at the FMC Operable Unit

The CSM must be updated to include not only slag, but other waste materials such as precipitator dust and calciner fines that have been used as fill.

FMC Response:

Please see the revision to Figure 2-10.

3. Section 2, Figure 2-10: Conceptual Site Model for Potential Human Exposure to Contaminants at the FMC Operable Unit

This figure must be modified to include infiltration/percolation as a possible primary release for areas operated without sustained hydraulic head. As stated in Specific Comment #10, this release mechanism depends on the timing and magnitude of infiltration, the magnitude and extent of the contaminant source term, the nature of the contaminant, and the hydraulic properties of the vadose zone. For many of the sites, this mechanism may be slow given site conditions and the nature of contaminants present, so no adverse impacts to groundwater are likely to occur. These issues must be described in the text.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004. In the proposed revisions, FMC recognized several potential sources to groundwater where a sustained hydraulic head was not applied. These changes are reflected in the CSM and in the text of Section 2 and Appendix A.

4. Section 2, Figure 2-10: Conceptual Site Model for Potential Human Exposure to Contaminants at the FMC Operable Unit

Former plant landfill (RU 19) does not appear to be listed and must be included under Primary Sources in the CSM.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004. The Former Plant Landfill in RU 19 has been added to the CSM as a primary source.

5. Section 2, Figure 2-10: Conceptual Site Model for Potential Human Exposure to Contaminants at the FMC Operable Unit

It is unclear why infiltration/percolation has been removed as a secondary release mechanism for areas operated with sustained hydraulic head. If the CSM has been drawn to take account of the remedial actions already in progress at these sites, data has not been presented to demonstrate that the remedies are fully effective at preventing contaminants in the vadose zone from migrating to the aquifer. The document must be revised to include the potential secondary release mechanism, with a footnote indicating that a remedial action (containment remedy) has been implemented to minimize these releases.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004.

6. Section 2, Figure 2-9: Excerpts from EPA Presumptive Remedy for CERCLA Municipal Landfill Sites

Add a line item to this table that includes an excerpt of the five typical primary response action objectives of the landfill presumptive remedy. These are found listed in Section 4 of the presumptive remedy guidance document (U.S. Environmental Protection Agency, 1993a). Note that the third response action objective is minimizing infiltration and resultant contaminant leaching to groundwater. This is a necessary component of the design for RUs 18 and 19, because of the uncertainties described in Specific Comment #10.

FMC Response:

The following response action objectives from the referenced EPA document have been added to Figure 2-9:

- Preventing direct contact with landfill contents;
- Minimizing infiltration and resulting contaminant leaching to ground water;
- Controlling surface water runoff and erosion;
- Collecting and treating contaminated ground water and leachate to contain the contaminant plume and prevent further migration from source area; and
- Controlling and treating landfill gas.

7. Section 2, Table 2-4, Comment 1, Comment Set 2

A recent study conducted by the Montana Department of Environmental Quality (Montana 2003) on slag from the Rhodia elemental phosphorus plant has shown that approximately half of the gross alpha activity in slag is attributable to radium-226. During the 1992 FMC RI, gross alpha levels at several road and slag fill sites were measured at levels greater than 200 pCi/g. Extrapolating the Montana 2003 results to FMC slag indicates that the radium-226 activity in slag could be in the range of 100 – 175 pCi/g. The RI Update Memo must be revised to identify radionuclide characterization of slag and other waste fill materials as a data gap.

FMC Response:

Please refer to the response to EPA's General Comment 3 and 4, and Specific Comments 30 and 31, which recognize the need to 1) further characterize the extent of radiological impact through gamma radiation measurements and 2) to characterize the extent of lead-210 in roads where precipitator dust may have been used during winter conditions to enhance traction. Revisions have been made to the December 2004 RI Update Memo in the appropriate sections.

However, FMC believes that the extrapolation of Montana data to radium-226 activities in FMC slag is inconsistent with analytical data. In EPA's 1977 study of radionuclides in FMC's feedstocks, byproducts, and waste materials (cited in the response to EPA General Comment 3 and 4), uranium-238 activities ranged from 18.6 to 29.4 pCi/g, and radium-226 activities ranged from 22.8 to 33.3 pCi/g. Gross alpha activities in slag samples were not determined in EPA's study. However, summation of alpha activities for the alpha-emitting radionuclides in slag samples analyzed by EPA results in gross alpha activities ranging from 162 to 229 pCi/g.

Uranium-238 activities in FMC slag samples analyzed during the EMF RI ranged from 22.1 to 30.7 pCi/g, and gross alpha activities in these slag samples ranged from 179 to 240 pCi/g. The similarity of uranium-238 activities between EPA's data and FMC's data, the actual radium-226 activities detected in EPA study, and the similarity in actual and calculated gross alpha activities indicates that the radium-226 activities extrapolated from the Montana data are not characteristic of FMC's slag. Moreover, it is unlikely that 50% of the gross alpha activity in the Montana slag would be attributable to radium-226. One should ask if the contribution to gross alpha from other alpha-emitting radionuclides in the uranium-238 decay series (such as U-234, Th-230, Po-210) were considered in reaching the cited conclusion. Perhaps some or all of these other radionuclides were not reported in the Montana data.

The decay of a Ra-226 atom would contribute 4 alpha particles (Ra-226 itself plus its short-lived alpha-emitting daughter products Rn-222, Po-218, Po-214) toward a gross alpha measurement. Without knowing the gross alpha activity of the Rhodia slag sample, we cannot estimate the Ra-226 activity. However, given the previous factor, it is more likely that the Ra-226 activity in the Rhodia slag is approximately 25 pCi/g rather than 100+ pCi/g.

8. Section 2, Table 2-4, Comment 5, Comment Set 2

Table 2-4 provides responses to EPA comments on the draft outline for the updated CMS. The response to comment 5 is inadequate because stormwater and sewer pipelines are not included in any RUs or the CSM. The document must be updated to include these items.

FMC Response:

Table 2-4 has been revised to show the storm drain in RU 3 and phossy water piping in RU 2 as potential release points in the CSM.

The RU's with underground process piping and sewer lines were discussed in Section 6 of the RI Update Memo. These features were identified as potential sources and the associated data gaps sections identify the need for additional data to characterize these features. Specifically, RU 1, RU 2, RU 12, RU 13, RU 3 (storm drain), and RU 22b had associated data gaps relating to underground piping. FMC proposed removal or capping the underground piping, depending on the RU. For RU 3, FMC has proposed a video survey of the storm drain.

9. Section 2, Page 2-1, last paragraph

The 1998 Record of Decision (ROD) does not restrict land use in the vicinity of the railroad swale. The ROD did not evaluate or discuss the hazard due to elemental phosphorus. Since elemental phosphorus was encountered in this area during the 1991 RI, the railroad swale must be reassessed in the SRI to ensure the remedy selected in the 1998 ROD is protective for future site uses.

In addition, an evaluation of all areas and remedies identified in the ROD needs to be included in the RI Update Memo to ensure that the remedies identified in 1998 will be protective for future site users.

FMC Response:

Actually, the 1998 ROD does specify that FMC implement legally enforceable land use controls to prevent possibility for future residential use of the FMC plant area including the railroad swale. However, the 1998 ROD did not specify institutional controls to prohibit subsurface intrusion within the lined (or capped) area at the RR Swale. FMC believes that this is the type of land use restriction contemplated in EPA's comment.

FMC believes that subsurface-intrusion prohibitions, which are a common element of land use controls recorded for the RCRA pond closures, are appropriate and consistent with FMC's capping remediation vision for the Railroad Swale (RU 22c). Section 2 of the RI Update Memo has been revised to note this.

FMC believes that the latter part of EPA's comment "...an evaluation of all *areas and remedies* [emph. added] identified in the ROD needs to be included in the RI Update Memo to ensure that the remedies identified in 1998 will be protective for future site users" requires information that is beyond the scope of the RI Update Memo. As noted in item 1.5 of the Statement of Work for the Supplemental Remedial Investigation / Supplemental Feasibility Study for the FMC Plant OU, the scope of the RI Update Memo is to:

1. Compare existing site characterization data to existing RBCs (including a proposed RBC for P4);
2. Identify the rationale for excluding any areas for further evaluation;
3. Identify areas for which data gaps exist and identify data needs for these areas
4. Identify characterization data for areas where adequate data exists to proceed with evaluation in the SFS, and
5. Assess potential ecological risks within the undeveloped areas of the FMC Plant OU for Cd, F, Zn, V, and Cr.

The RI Update Memo already includes evaluation of post-ROD activities and releases that may have influenced the nature and extent of impact at *areas* previously identified in the ROD. This evaluation found, for example, that additional releases of P4 to the Railroad Swale (RU 22c) occurred subsequent to the 1998 ROD, and that additional site characterization is needed to evaluate the scope of a capping remedy at this source area.

An evaluation of the continued protectiveness of the *remedies* identified in the 1998 ROD is an appropriate element of the Supplemental Feasibility Study (SFS). Consequently, FMC has not revised the RI Update Memo to present an evaluation of the protectiveness of remedies identified in the 1998 ROD.

10. Section 2.2.1, Pages 2-7 & 2-8, Areas Operated without Sustained Hydraulic Head

As stated in comments on the Scoping and Planning Memorandum and as we have discussed in subsequent meetings, the contention that all sites grouped under the category of "Areas operated without Sustained Hydraulic Head" could not adversely affect groundwater is not supported by the information available. Infiltration of precipitation through contaminated source areas and site soils in the vadose zone could transport contaminants to the aquifer. The potential for aquifer contamination above risk based concentrations resulting from this release mechanism depends on the timing and magnitude of infiltration, the magnitude and extent of the contaminant source term, the nature of the contaminant, and the hydraulic properties of the vadose zone. Most of the RI sampling consisted of sampling for heavy metals, fluoride, and total phosphorus. These contaminants tend to adsorb to soil particles and not migrate quickly through the vadose zones, unless soil pH is low. However, other contaminants (such as some of the organic compounds) would be much more prone to migration resulting from infiltration.

Few samples were collected for organic analyses in the RI. For example, only one boring was completed in active landfill site RU 18, and there was no sampling conducted at the old landfill in RU 19 because the waste zone is inaccessible. Since a laboratory was operated at the facility and organic constituents were encountered during closure of the RCRA drum storage area organic contaminants are known to be have been present at the facility. At the chemical laboratory seepage pit (in RU 5), toluene was detected at every depth in soil boring F028B (ranging from 31 to 159 ppb), and two of the depth horizons sampled (0 and 20 feet) in the other boring (F029B). Several other organic compounds, including TCA (F028B), xylenes (F029B) and ethylbenzene (F029B) were detected at a depth of 70 feet. Several inorganic contaminants were also detected at elevated concentrations at depth in these two boreholes (EMF RI, pages 4.2-120 through 121). Organic compounds were also detected at various depths in samples collected from the boring completed in the active landfill. Compounds including toluene, xylenes, and ethylbenzene, among others, were detected in soils beneath this landfill. The RI asserted that the organic compounds detected could be laboratory contamination; however, several of these organic compounds were not detected in corresponding blank samples. Although no samples were collected from the former plant landfill, process knowledge suggests that the former plant landfill in RU 19 is likely to contain a greater volume of spent solvents compared to RU 18 (RI Update Memo, Section 6). Hence the contaminant source term that would be prone to leaching could be larger than what exists at RU 18.

Therefore, on the basis of process knowledge and the limited data for organic contaminants collected during the original RI, there appears to be potential for contaminant migration from the waste zones under conditions without sustained hydraulic head. The conceptual site model must be revised to include this. For landfill sites RU 18 and 19, the CERCLA presumptive remedy for municipal landfills, with the response action objective of minimizing infiltration and resulting contaminant leaching to groundwater, must be applied. The long-term remedy must include groundwater monitoring at these sites to assess the effectiveness of the landfill containment remedy. The SRI or SFS should assess whether the existing well network is appropriately located to intercept groundwater flow from the landfills. Additionally, the SRI should evaluate such sites as the chemical laboratory leaching pit, and the disposal area behind the laboratory, to determine whether there could be adverse impacts to site groundwater from infiltration/leaching of more mobile contaminants at these sites.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004. Revisions were made to the CSM, Section 2 text, and Section 6 text to address this comment. The December 2004 RI Update Memo now reflects the uncertainties relating to potential sources with intermittent applied head and/or potential free liquids, and their potential for being sources to groundwater.

11. Section 2.2.1, Page 2-6

The RI Update Memo must include a discussion of the Industrial Waste Water (IWW) sediments and the former carbon monoxide (CO) flare pit, and other units now buried at the facility.

FMC Response:

Section 2.2.1 of the RI Update Memo presents an update for potential sources that were not described in the original conceptual site model for the EMF Site and changes in the characteristics of several potential sources that were included in the original conceptual site model.

The original conceptual site model identified the IWW Ditch as a primary potential source and surface water and sediment as related exposure media. The IWW discharge to the Portneuf River was terminated in August 2002, as noted in the RI Update Memo. Consequently, the updated CSM does not identify the IWW Discharge as a point source. The updated CSM in the June 2004 RI Update Memo did recognize residual sediments (i.e., soils) within the IWW ditch and IWW Basin as potential sources. However, the discussion of the IWW discharge in the RI Update Memo has been expanded to clarify that residual sediments within the IWW Ditch and IWW Basin are classified as potential (soil) sources in the updated CSM.

FMC believes that the former carbon monoxide flare pit was included within the "Stacks and Vents" source identified in the original conceptual site model (see EMF ROD, Figure 23). However, for clarification, FMC has revised Section 2.2.1 of the RI Update Memo to update information specific to the former CO Flare Pit. The discussion will note that air emissions from this unit terminated in June 2000, and that the slag berm surrounding the former Flare Pit and slag within the perimeter of the pit were removed down to native soil.

FMC is not aware of any units now buried at the facility that were not already identified in the June 2004 draft of the RI Update Memo.

12. Section 2.2.2, Page 2-8, Infiltration/Percolation, Last Sentence

As discussed in comment 3 and 10, it appears that infiltration/percolation is a viable release mechanism for sites operated without a sustained hydraulic head. Inorganic contaminants have also been shown to have migrated from waste sites under conditions without sustained hydraulic head (e.g., RU 16: Calciner Solids Stockpile; RU-5 Chemical Laboratory Seepage Pit). Figure 2-10 must be revised to include, in the list of units, the Slag Pit Wastewater Sump, and areas within the furnace building and phos dock as having been operated without sustained hydraulic head.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004. Figure 2-10 identifies "seepage/percolation" to groundwater from RU 1 and RU 2 SWMUs and P4 working areas, including the Phos Dock and Furnace Building. Note that the slag pit wastewater sump was operated with an applied head, and including it in the list of units as having been operated without a sustained hydraulic head would be incorrect.

13. Section 2.2.3, Page 2-9

The wastewater currently treated at the Pond Closure Decant Treatment System (PCDT) water treatment system then used for dust suppression is not discussed in the RI Update Memo. The RI Update Memo must be revised to include the areas where the wastewater was used for dust suppression as potential source areas.

FMC Response:

The PCDT water has been applied to roads within the FMC Plant OU. The December 2004 RI Update Memo identifies road segments within RU's and RU 23 as potential source areas, and identifies associated data gaps for all road segments.

Section 6.1.4, RU 23, has been revised to incorporate a discussion on constituent mass loading to FMC Plant OU roadways resulting from the use of PCDT water for dust suppression.

14. Section 2.2.3, Page 2-10, Groundwater

The document must be revised to state that leaching of contaminants from certain sites without sustained hydraulic heads may also impact groundwater quality.

FMC Response:

These revisions are included in the December 2004 RI Update Memo.

15. Section 2.2.4, Pages 2-10 & 2-11

For development of SSLs and screening purposes, FMC must use 0-10 ft bgs for the future construction worker scenario. For soil characterization purposes FMC indicates that construction workers engaged in excavations for facility construction projects could be exposed to the upper five to six feet of soil. Justification for this site-specific assumption and deviation from EPA's recommended default exposure parameter soil depth interval for construction worker of zero to ten feet (0-10 ft) below ground surface (bgs) must be provided.

FMC Response:

FMC has revised the Construction Worker Exposure scenario to reflect EPA's default soil exposure depth interval of 0 – 10 feet. Appropriate conforming changes were also made in Sections 4, 6, and Appendix C.

16. Section 2.2.4, Pages 2-11 & 2-13, Footnotes 11 & 13

Footnote 11 on page 2-11 conflicts with Footnote 13 on page 2-13. On 2-11, Footnote 11 states that the potential presence of solvent and petroleum hydrocarbon contamination is believed to be restricted to RU 5, 12, 20, and 22b, whereas Footnote 13 on page 2-13 indicates that this contamination is restricted to RU 20. This discrepancy must be rectified.

FMC Response:

Agreed. FMC has revised footnote 13 to read as does footnote 11.

17. Section 2.3, Page 2-12

Since groundwater is used for irrigation in the area, an assessment of whether use of groundwater for irrigation would be protective for human health and the environment must be included in the SRI and described in the RI Update Memo and associated CSM.

FMC Response:

FMC does not believe that an assessment of whether use of groundwater for irrigation would be protective for human health and the environment should be included in the SRI or described in the RI Update Memo and associated CSM.

Groundwater within the FMC Plant OU has not been used for crop irrigation and such use in the future is unexpected for several reasons. First, engineered covers either have been, or are expected to be, placed over at least 20% of the area of the FMC Plant OU to minimize water infiltration and exposure to underlying waste materials. Agricultural use of these capped areas (with or without irrigation) would be inconsistent with RCRA Closure Plans, remedies identified in the 1998 ROD and anticipated ROD amendment, and the Remedial Action Plan for the Calciner Ponds. Second, many other portions of the FMC Plant OU either have steep or irregular topography and soil conditions that make them unsuited for agricultural use, are paved or occupied by rail tracks, or are covered with slag, which is unsuited to agricultural use. Finally, future use of the FMC Plant OU is anticipated to be commercial or industrial, as noted in the RI Update Memo. Crop production would be inconsistent with commercial or industrial uses of the property. Therefore, the December 2004 RI Update Memo has not been revised.

18. Section 2.3, Page 2-13, Potential Sources, 2nd, Paragraph, 3rd Sentence

The referenced sentence states that, "the RI also found that potential sources that operated without a sustained hydraulic head did not contribute to contamination of the uppermost aquifer." This sentence is too broad. As discussed in Specific Comment #10, the limited data for organic contaminants collected during the original RI indicates that at some sites there has been contaminant migration from the waste zones under conditions without sustained hydraulic head. Currently, there may not be monitoring wells located appropriately to intercept potential releases from these sites. In addition, the RI Update Memo describes measured groundwater impacts that are believed to have occurred as a result of infiltration/percolation from sites that are shown Figure 2-19 to have operated without a sustained hydraulic head (Appendix A, Page A-5, second bullet). Modify the sentence to acknowledge this uncertainty.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004.

19. Section 2.3, Page 2-13, Potential Sources, 3rd paragraph

In section 2.3 the text states that contamination of surface soils by deposition of former emissions from the FMC and Simplot facilities will be recognized as a secondary source. However, there appear to be no plans to conduct sampling to evaluate the nature and extent of the deposition. As discussed in comment #5, the southern and western portion of the facility have most likely received contaminants from air deposition. The SRI must include soil concentrations in these areas as a data gap requiring additional investigation.

FMC Response:

Please see response to Comment 5. No revisions have been made to the December 2004 RI Update.

20. Section 2.3, Page 2-13, Potential Sources

In section 2.3, potential source areas must be revised to include roads and areas where waste and slag materials were used for fill.

FMC Response:

As stated in the June 2004 RI Update Memo, the EMF RI and other investigations have shown the following: "Fill within the FMC plant area consists mostly of slag. Some areas have ore and slag mixed in the fill, and in a few areas, precipitator dust was observed in the fill material."

21. Section 2.3, Page 2-14, Potential Release Mechanisms, 5th Bullet

This bullet must be revised to state: " Infiltration and percolation into soils and groundwater from unlined waste management units." Infiltration and percolation into soils and groundwater is a potential release mechanism for waste management units operated without a sustained hydraulic head.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004.

22. Section 2.3, Page 2-15, Exposure Medium Groundwater, 1st Paragraph, 1st Sentence

As discussed in specific comment #10, the text must be revised to acknowledge the uncertainty regarding the impact to groundwater from sites with more mobile COCs in areas that have been operated without sustained hydraulic head.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004.

23. Section 2.3, Page 2-15, Groundwater

The text states that FMC and Simplot industrial activities have contaminated the uppermost aquifer. The 1998 ROD states that EMF operations have contaminated the shallow aquifer and the upper levels of the lower aquifer.

Since the FMC plant closure, groundwater is now extracted at a greatly reduced rate. The RI update should include an evaluation to determine the effect this has on groundwater flow.

The SRI must include groundwater data focusing on the following:

- Continuity and integrity of the American Falls Lake Bed aquitard
- Hydraulic relationship between the shallow and deep aquifers at the source area and downgradient areas.
- Deep aquifer water quality monitoring (groundwater sampling) at selected locations.

If inadequate information exists the SRI must be modified to identify this as a data gap and information must be collected during the SRI to assist with development of a long-term groundwater monitoring strategy.

FMC Response:

The RI Update Memo has been revised to include the following text:

> "The EMF RI identified low levels of site-related contaminants in the deeper aquifer in very limited areas of the FMC Plant OU, and at very low concentrations (below MCLs, and only slightly elevated above background levels). The American Falls Lake Beds were delineated beneath the FMC plant area as well as the old pond area (See Sections 3.3, 4.4, and Appendix K of the EMF RI Report).
>
> Vertical gradients were evaluated during the EMF RI and in subsequent groundwater monitoring events. Monitoring well pairs located near the Simplot and FMC production wells displayed upward vertical gradients while the production wells were pumping, with the exception of slight downward gradients in the Shallow/Deep well pair 126/125 near FMC's production well FMC-3. These wells are located in a portion of the FMC Plant OU that has no indication of impacted groundwater quality. The localized and minor downward gradients were directly a result of deep groundwater extraction and would not induce the downward migration of contamination to the deeper aquifer because the shallow groundwater in this area is not impacted. Overall, there was no inducement of downward gradients from these production wells that could have affected the deep aquifer within the FMC Plant OU. Sections 3.3 and 4.4 of the EMF RI provide further information.
>
> The EMF RI investigated the future scenario where all groundwater pumping ceased at Simplot and FMC. There was no change in the shallow groundwater flow patterns. Capture zones in the deeper aquifer were eliminated and larger volumes of deep groundwater were

available for discharge to the river and springs. FMC's groundwater monitoring data collected since the plant shut down in December 2001 support these conclusions.

Because deeper groundwater was not significantly impacted by FMC sources, and because the deeper aquifer has a significantly greater flux of water, downgradient water quality should improve as a result of decreased pumping from the deeper aquifer. This is because the residual contaminants in the shallow aquifer will be diluted by a much greater flux of clean, deep groundwater in the region near the Portneuf River and Batiste Spring.

While the ROD may have stated that it is unclear what effects there may be from cessation of groundwater pumping at the EMF Site, the EMF RI Report presented a model scenario that simulated groundwater flow patterns with facility wells no longer pumping (FMC and Simplot production wells).

As shown in Section 3.3 (Figures 3.3-16 and 3.3-17) and Appendix K of the EMF RI, the primary difference between the scenarios with groundwater extraction vs. no extraction was a higher flux of deeper (clean) groundwater to the river and springs. It was determined that upward vertical gradients between the deeper and shallow aquifer persisted during the RI period, when FMC and Simplot were pumping the deeper aquifer at a maximum rate (875 gpm for FMC wells, 3,300 to 4,000 gpm for Simplot wells). A reduction in pumping rates will add another level of protection to the deeper aquifer by increasing the upward vertical gradients (reducing drawdown in the deeper aquifer)."

The EPA-approved Scoping and Planning Memorandum (FMC, 2004) states that the primary focus of the SRI/SFS is the shallow (<=10 feet) soil or fill. EPA also acknowledges this as the focus of the SFS in the SRI/SFS Consent Order SOW. The comment may not have been written with an understanding of the Statement of Work (SOW) for the SRI/SFS (EPA, 2003), or the approved Scoping and Planning Memorandum (FMC, 2004). The SOW notes: "It is anticipated that the SFS will focus on the Soils/Solids Media, including the soils/solids to groundwater pathway, because the air and groundwater pathways were evaluated on a site-wide basis in the 1997 feasibility study." [Footnote 2 in the RI Update notes that FMC provided EPA a summary of post-RI groundwater monitoring data collected by FMC (Bechtel 2002). These data were consistent with the data presented in the RI Report.]

24. Section 2.3, Page 2-16, 1st paragraph

The text states that worker exposure to contaminated surface and subsurface soils is currently minimized by administrative controls, physical barriers and security systems and states further that the updated CMS assumes the potential exposure pathways applicable to current workers are applicable to future workers. Physical barriers and security systems can not be assumed to be in place for future industrial/worker scenarios. If these measures are necessary to ensure protection of future workers, these measures need to be included as a component to the remedy.

<u>FMC Response:</u>

The need for these measures will be considered in the evaluation of remedial action alternatives in the Supplemental Feasibility Study. No revisions were made to the December 2004 RI Update.

25. Section 2.3, page 2-16, last paragraph

The 1998 ROD does not distinguish between the upper and lower aquifer, while the RI Update Memo implies that the deep aquifer meets MCLs and use of the deep aquifer is not restricted. The ROD requires that use of "the aquifer" be restricted. The ROD needs to be revised to specifically state that the shallow aquifer does not meet MCLs and it's use is restricted if the RI update memo makes this distinction, otherwise the RI update must be revised to be consistent with ROD.

FMC Response:

Section 2 of the RI Update memo has been revised to clarify that the restrictions on groundwater use specified in the 1998 ROD are applicable to both the upper and lower aquifers. FMC did not intend to imply in the June 2004 draft of the RI Update Memo that restrictions were applicable only to the upper aquifer.

26. Section 3.4, Page 3-7

This section does not include a comprehensive summary of waste materials characterization data at the EMF facility. Studies which are missing include the Toluene Insoluble work, the Zimpro pilot studies completed as part of the LDR Treatment Plant project, calciner solids studies, waste water (PCDT) treatment studies. All existing data that would help understand wastes managed at the site and identify contaminants of concern must be referenced.

FMC Response:

Descriptions of the Toluene Insolubles study, the ZIMPRO pilot study, the calciner solids studies, and the PCDT treatment studies have been added to Section 3. The radionuclide speciation data discussed during the 9/15/04 teleconference have also been added.

27. Section 3.3, Page 3-7, SWMU 63

Since no analytical data exists to confirm the clean closure of this unit, soil samples must be taken in the vicinity of the tanks to demonstrate that elemental phosphorus and contaminants of concern associated with product are at levels are below the RBC. In addition, the fill should also be characterized for inorganic and radionuclides.

FMC Response:

Please refer to the discussion of data gaps for RU 6 in Section 6 of the RI Update Memo. Data gaps include a lack of inorganic characterization in shallow (0-10') soils, gamma radiation, and elemental phosphorus.

28. Section 3.4, Page 3-8, Coke Analyses

The text must explain why the TCLP samples of coke from the Kemmerer, Wyoming facility are representative of materials that would be present at FMC in Pocatello.

FMC Response:

In Section 3.3, the intent was to present new or additional data that was not presented in the EMF RI, it was not intended to justify whether or not additional data are needed to characterize certain materials/soils. A more detailed discussion of available data is provided in Section 6 (see below).

In the discussion of data gaps in RU 20, the RI Update Memo identifies the following data gap:

"Characterization of residual coke is needed to support a decision to either forward RU 20 to the SFS or determine that no further action is needed."

Related to RU 7 Coke Handling:

"Coke has not been characterized at RU 7, and the nature of coke used by FMC will be characterized to evaluate a decision of no further action. The vertical extent of the coke will be assessed to determine if mechanical mixing with shallow soils has occurred."

29. Section 4

Exposure to specific radionuclides must be included in the SRI and discussed in the RI Update Memo. The "Soil Screening Guidance for Radionuclides: User's Guide" October 2000, OSWER No. 9355.4-16A, NTIS Order Number (PB2000 963307), and "Soil Screening Guidance for Radionuclides: Technical Background Document" October 2000, OSWER 9355.4-16, NTIS Order Number (PB2000 963306) provide information on soil screening for radionuclides when setting remediation goals at CERCLA sites with radioactive contamination. The "Soil Screening Guidance for Radionuclides: User's Guide" presents standardized exposure parameters and equations for calculating radionuclide preliminary remediation goals (PRGs) for residential land use exposures. These documents have been recently superseded with revised spreadsheets posted on the web. While many areas of the guidance remain unchanged, it is advisable to use the most recent guidance.

Preliminary Remediation Goals for Radionuclides Excel Spreadsheets can be used as a starting point for PRGs. Additional analyses may consider site-specific exposure modifications or comparisons with natural background levels of COPCs (U.S. Environmental Protection Agency, 2002c). The radionuclide PRG guidance and spreadsheets are available from the following web site:

http://epa-prgs.ornl.gov/radionuclides/prg_guide.shtml

FMC Response:

As discussed during both the August 3 and September 15, 2004 teleconferences, and documented within Appendix F of the December 2004 RI Update Memo, FMC has analyzed available radionuclide-specific data that characterize the content of the various feedstocks and waste materials that comprise the contaminant sources at the FMC Plant OU. These analyses have determined that external exposure to gamma radiation comprises the majority of the risk to future workers for all source materials, except phossy solids.

Consequently, external gamma dose rate measurements will be collected during the SRI, in lieu of radionuclide-specific analyses, in all areas except those found to contain phossy solids. For phossy solids, exposure to lead-210 and polonium-210 via incidental soil ingestion and inhalation of fugitive dusts contributes as significantly to overall worker risk as exposure to external gamma radiation. Consequently, in addition to external gamma dose rate measurements, analyses of lead-210 and polonium-210 will be performed in areas found to contain phossy solids during the SRI.

As also discussed during the September 15, 2004 teleconference, background radiological cancer risk in the EMF study area is greater than 1 in ten thousand (1×10^{-4}). Consequently, using the guidance documents referenced in the comment to develop radionuclide-specific soil screening levels (SSLs) at EPA's default target risk threshold of 1 in a million (1×10^{-6}) will not help in interpreting the significance of the SRI findings. Instead, as discussed during the September 15, 2004 teleconference and documented in the December 2004 RI Update Memo, the radiological data collected during the SRI will be used to compare potential worker exposure to a target dose threshold of 15 mrem/year above background (equivalent to an incremental cancer risk of 3×10^{-4}); the same radiological remedial action objective (RAO) established for off-site soils at the Monsanto Soda Springs elemental phosphorus production CERCLA site.

30. Section 4, Page 4-2, 2nd paragraph

The rationale for excluding radionuclides from the RI Update Memo and SRI and relying only on gamma emission data to assess risks at the site is not consistent with EPA guidance. EPA guidance documents should be used as a guideline to develop a RBC for radium-226 and other radionuclides. The SRI must be revised to identify radionuclide concentrations as a data gap and propose data collection for COPCs and an evaluation of radionuclide levels believed to be present at the facility.

It is stated that because the human health risk assessment (HHRA) determined that external exposure to gamma radiation contributed 95% of the total risk from outdoor exposure to radionuclides by future workers in the FMC subarea, gamma radiation dose measurements will be used for screening purposes. This appears to be a modification of the concentration-toxicity screen detailed in RAGS, except that types of radioactive decay (beta, alpha) and exposure routes (particulate inhalation, soil ingestion) rather than COPCs are being screened. This approach regards risk from exposure routes such as inhalation and soil ingestion as insignificant. The RI Update Memo does not demonstrate that this method is appropriate for all areas of the site and types of materials (e.g., slag versus calciner solids stockpile) that might contain different ratios or types of isotopes. Additionally, the HHRA was based on estimated levels of radionuclides as no samples of radionuclides were collected during the 1996 RI. Risks calculated in the HHRA may not be accurate due since radionuclide levels were only estimated and no sampling has been conducted to determine whether the assumptions made at that time are accurate. The RI Update Memo must identify radionuclide specific concentrations/activities as a data gap and identify that data will be collected so risks posed by these COPCs and exposure pathways can be evaluated in the RI Report.

FMC Response:

FMC agrees that the June 2004 RI Update Memo did not identify lead-210 and polonium-210 in phossy solids as a data gap; the December 2004 RI Update Memo has incorporated appropriate revisions. Because exposure to external gamma radiation contributes the vast majority of potential radionuclide risk to future workers for all source materials (except phossy solids) at the FMC Plant OU, comparing direct exposure measurements of gamma radiation to a dose-based target (e.g., 15 mrem/yr above background as used at Monsanto) will effectively ensure the protection of these potential receptors. For areas that may contain phossy solids, the collection of lead-210 and polonium-210 data will characterize the potential risks associated with the ingestion and inhalation pathways. These radionuclide-specific investigations will be used in conjunction with gamma measurements to determine whether worker exposures exceed the 15 mrem/yr above background threshold.

The methodology, assumptions and findings of the analyses performed to support FMC's position are fully documented in Section 4 and Appendices F, G, and H of the December 2004 RI Update Memo.

As discussed during both the August 3 and September 15, 2004 teleconferences, FMC acknowledges that EPA's Superfund guidance for evaluating radionuclides generally does recommend the collection of radionuclide-specific data. However, the proposed approach of using gamma radiation dose rate measurements to evaluate radionuclides during the SRI/FS of the FMC OU is not unprecedented, and several EPA guidance documents specifically identify circumstances under which it is desirable to collect direct exposure rate measurements of gamma radiation.

EPA's *Radiation Risk Assessment at CERCLA Sites: Q and A* (EPA, 1999) (http://www.epa.gov/oerrpage/superfund/resources/radiation/radrisk.htm), identifies the merits of collecting gamma radiation dose rate measurements, and deriving cancer risk estimates directly from these data (see response to question 33 in EPA, 1999). EPA (1999) notes that this approach eliminates potential modeling uncertainties associated with estimating external gamma radiation exposure and concerns about the shape of the source (e.g., slag pile on FMC OU). EPA (1999) also cautions that such data only reflect a sub-set of the radionuclides and exposure pathways of potential concern (e.g., only external exposure from gamma-emitting radionuclides in near-surface soil), and may present an incomplete picture of overall radionuclide-related site risks. EPA (1999) indicates that, in most cases, more accurate estimation of radiation risks will require additional site characterization data, including concentrations of all radionuclides of concern in all pertinent environmental media because of the potential for other pathways to contribute to overall risk. However, as discussed further below and provided in Appendix F of the December 2004 RI Update Memo, radionuclide-specific data characterizing the content of the various feedstocks and waste materials historically processed at the FMC Plant OU are available. Moreover, analyses of these data demonstrate that exposure pathways other than external exposure to gamma radiation do not contribute significantly to overall worker risk for all source materials, except phossy solids.

Further support for FMC's proposed approach is presented in the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),* which was developed by the Departments of Defense and Energy, EPA, and the Nuclear Regulatory Commission to provide detailed guidance for planning, implementing, and evaluating environmental and facility radiological surveys conducted to demonstrate compliance with a dose- or risk-based regulations (http://www.epa.gov/radiation/marssim/index.html). Specifically, page 4-7 of MARSSIM (EPA et al., 2000) states that measurement of exposure rates may be used as a surrogate for surface or volume activity concentrations for radionuclides that deliver the majority of their dose through the direct radiation pathway. That is, instead of demonstrating compliance with radionuclide-specific soil or surface contamination derived concentration guideline levels (DCGLs) (i.e., cleanup goals) derived from the direct radiation pathway, compliance is demonstrated by direct measurement of exposure rates.

Furthermore, MARSSIM indicates that this surrogate approach may still be possible for sites that contain radionuclides that do not deliver the majority of their dose through the direct radiation pathway, provided that a consistent relative ratio for the radionuclides that do deliver the majority of their dose through the direct radiation pathway can be established. As stated in FMC's August 3 and September 15, 2004 presentations, the HHRA identified the external exposure to gamma radiation pathway as contributing over 95% of the total radionuclide cancer risk to a potential future worker. As documented in Appendix F of the RI Update Memo, radionuclide-specific data characterizing the composition of historical feedstocks and waste streams at the FMC OU confirm that, with the exception of phossy wastes, external exposure to gamma radiation contributes approximately 96 to 98.5% of the total radionuclide cancer risk to a potential future commercial/industrial worker exposed to any source material that poses a risk greater than that associated with exposure to background native soils (ore, calcined nodules, slag, and calciner pond sediment). Similarly, as also documented in Appendix F, with the exception of phossy wastes, external exposure to gamma radiation contributes 81 to over 89% of the total radiological risk to a potential future construction worker exposed to any subsurface source material that poses a risk greater than that associated with exposure to background native soils. Therefore, given both the high degree to which external gamma radiation contributes to total risk, and the relatively consistent ratio of external gamma radiation risk to total risk for each source material of potential concern, it is reasonable to conclude that, per the approach described in MARSSIM (EPA et al., 2000), direct gamma radiation measurements can be used during the SRI as a surrogate for radionuclide-specific activity data for areas of the FMC Plant OU that do not contain significant quantities of phossy solids.

With respect to areas containing significant quantities of phossy solid fill material, exposure to lead-210 and polonium-210 through the incidental soil ingestion and fugitive dust inhalation pathways would contribute as significantly as exposure external gamma radiation to total radiological risk to future workers. With respect to phossy solids, incidental soil ingestion and fugitive dust inhalation of lead-210 and polonium-210, in conjunction with exposure to external gamma radiation, accounts for over 98% of the total risk to any future worker exposed to this media. Thus, a supplemental remedial investigation strategy targeted on analysis of lead-210, polonium-210 and gamma dose rate measurements can be developed to ensure acceptable residual radiation risk in phossy waste-containing RUs where no further remedial action is contemplated in FMC's remediation vision. Appendix H of the RI Update Memo describes the approach that will be taken to confirm the presence of phossy waste during the SRI.

Finally, despite guidance indicating that dose assessments should generally not be performed to assess risk or to establish cleanup levels, this approach has been applied at sites comparable to the FMC Plant OU. Specifically, one of the RAOs established for off-site soils (property surrounding the plant) at the Monsanto elemental phosphorus production site located in Soda Springs, Idaho is to prevent exposure to radionuclides in soils at levels that pose cumulative estimated risks of 3×10^{-4}, by meeting a radiation effective dose equivalent of 15 mrem/year above background (EPA, 1997; EPA, 2003).

31. Section 4.3, Page 4-2, 3rd Paragraph

Dose rate surveys may be useful for estimating dose and risk. If background levels are exceeded, risks above background may be estimated. It is not necessarily the case, however, that background readings correspond to acceptable risk levels.

The proposal is made to screen gamma risk using gamma radiation dose rate measurements. The ability of this approach to detect risk-based screen levels of gamma radiation must be evaluated in the RI Update Memo. The dose rate that correspond to risk-based screening levels is likely to be small compared with the variability in background dose rates and the detection capability of the instrument in the background. As is the case with laboratory radioanalyses, detection capabilities will largely be determined by the variability of the background measurements. If the total gamma background (i.e. 13 uR/hr) is used as the basis for background comparisons, then the variability will be significant. It is not clear that the proposed method will be able to detect gamma dose rates corresponding to risk-based screening levels (e.g. 1E-4 risk). A data quality evaluation must be provided to demonstrate that the proposed screening method can meet the risk-based decision criteria for the site.

FMC Response:

The ability of gamma dose rate measurement instruments to detect worker risk-based screening levels of gamma radiation (approximately 8 μR/hr) is documented in Appendix G of the December 2004 RI Update Memo. Specifically, EPA's Data Quality Objectives (DQO) process was applied to confirm that a Pressured Ionization Chamber (PIC) is capable of reliably quantifying gamma radiation rates at the levels needed to assess risks to potential future site workers. Additionally, information was provided to demonstrate that a Bicron NaI instrument can be coupled with a PIC to increase coverage and to determine the variability in gamma radiation intensity across the site. In accordance with the comment and Action Item #30 identified during the September 15, 2004 Agency Coordination Meeting teleconference, the confirmatory data quality evaluation will be further documented in the SRI Work Plan

32. Section 4, Page 4-1, 1st paragraph

RBCs for Elemental Phosphorus and Other COPCs, Page 4-1. The text and RBC calculations should be updated to apply the most updated toxicological criteria provided in USEPA's HEAST 2001. Currently, the document references HEAST 1997, and the radiological slope factors in HEAST 1997 have been comprehensively updated in HEAST 2001. The RBCs should be updated in accordance with the updated guidance.

The text must be revised to list web sites, date accessed, and revision dates for cited online toxicity references.

Example:

U.S. Environmental Protection Agency. (1992). IRIS Toxicity Profile for Zinc and Compounds. Accessed: August, 12, 2003. Revised: October, 1992. http://www.epa.gov/iris/subst/0426.htm

FMC Response:

In accordance with the comment, the RI Update Memo has been revised to list the web address and date of access of online toxicity references. In addition, the latest revision date provided on the web site is documented.

As stated in the comment, radiological cancer slope factors were updated in the 2001 version of EPA's Health Effects Assessment Summary Tables (HEAST); however, RBCs are not developed for radiological constituents in the RI Update Memo. Instead, the RI Update Memo develops RBCs, otherwise known as soil screening levels (SSLs), for elemental phosphorus and other chemical COPCs. The 2001 HEAST publication does not contain updated toxicological criteria for chemicals. The most recent version of HEAST that provides toxicological criteria for chemicals was published in 1997. In summary, the 2001 version of HEAST does not contain any information relevant to the derivation of the chemical RBCs presented in the RI Update Memo and is not referenced in Section 4 of the December 2004 RI Update Memo.

33. Section 4, Page 4-2, 3rd paragraph, 2nd sentence

The text refers to gamma radiation as a radiation-related COPC. Strictly speaking, gamma radiation is not a COPC; rather, the radionuclide, which emits the radiation, is the COPC. The document should be revised to clarify this.

FMC Response:

It is agreed that specific radionuclides, rather than gamma radiation, constitute the COPCs. While this distinction is made in the December 2004 RI Update Memo, and gamma radiation dose rate measurements are identified as a surrogate to be used to evaluate radiation-related risk from exposure to gamma emitting COPCs within the SRI/SFS.

34. Section 4.2.1, Page 4-5, 2nd paragraph

In the last sentence there is a reference to ground water containing COPCs in excess of MCLs or SSLs. Since the latter acronym stands for Soil Screening Level, it is not appropriate for ground water and must be changed.

FMC Response:

Agreed. The last sentence of the cited paragraph has been revised to read "... FMC will record land use restrictions to prevent future workers from being exposed to groundwater containing COPC concentrations in excess of Maximum Contaminant Levels (MCLs) or risk-based screening levels."

35. Section 4.2.2, Page 4-7, Exposure via Soil Ingestion and Dermal Absorption, 5th paragraph

The first sentence begins: "By contrast to cancer slope factors, the following hierarchy was used to select noncancer toxicity values:" However, the hierarchy for cancer and noncancer toxicity values is essentially the same. The text should be revised to state that the same hierarchies were used.

FMC Response:

The hierarchy for cancer and chronic non-cancer toxicity values is the same. The first sentence of the cited paragraph has been changed to "The same hierarchy for developing cancer slope factors was used to select chronic noncancer toxicity values:"

36. Section 4.4.3.2, Page 4-21, Equation 4-26

Equation 4-26 does not match the Equation E-21 in EPA's Supplemental Soil Screening Guidance (U.S. Environmental Protection Agency, 2002e). The conversion factor from kilograms to grams appears to be incorrect. The equation should be revised using a conversion factor of 1,000 g/kg.

FMC Response:

A value of 4×10^3 g/kg, rather than 1×10^3 g/kg, was an inadvertent typographical error. The equation will be corrected as requested; however, it should be noted that the SSL calculations were correctly performed using a conversion factor of 1,000 g/kg.

37. Section 4, Table 4-1

Table 4-1 must be revised to include the following chemicals and radionuclides:

Chemical	Risk Based Concentration	Source
Cobalt	1,900 mg/kg	(Smucker, 2004)
Lead	800 mg/kg	(U.S. Environmental Protection Agency Technical Review Workgroup for Lead (TRW), 2002h)
Lead-210	1.23 pCi/g	(U.S. Environmental Protection Agency, 2002c)
Phosphorous (elemental)	20 mg/kg	(Smucker, 2004)
Radium-226	0.0258 pCi/g	(U.S. Environmental Protection Agency, 2002c)
Uranium (total, noncancer)	200 mg/kg	(Smucker, 2004)
Uranium-238	1.8 pCi/g	(U.S. Environmental Protection Agency, 2002c)

FMC Response:

As discussed on page 4-1 of the RI Update Memo, the purpose of Table 4-1 is to present the original EPA calculated worker RBCs documented in the 1997 Feasibility Study (FS) Report of the FMC Subarea. The information provided in the comment is not relevant to the 1997 FS Report and, consequently, has not been incorporated into Table 4-1. However, Table 4-1 has been renamed "EPA Calculated Worker Risk-Based Concentrations (RBCs) for the FMC Subarea[1]". The reference at the end of the title refers to a footnote that identifies the 1997 FS Report as the source of the information presented in the table.

38. Section 4, Table 4-4

The soil adherence factor for the utility worker must be revised to 0.9 mg/cm2 (U.S. Environmental Protection Agency, 2004). The EPA Dermal Exposure Guidance (RAGS-E) has been revised and finalized (U.S. Environmental Protection Agency, 2001b; 2004), must be reviewed for changes which may impact the exposure assessment and PRG development.

<u>FMC Response:</u>

The soil adherence factor for the utility worker has been revised to 0.9 mg/cm^2 in accordance with the recommendation contained within Exhibit 3-3 of EPA's recently finalized *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (July, 2004). The remainder of the final guidance document has been reviewed and there is no additional information in that document that affects the dermal absorption assumptions incorporated into the SSL calculations within the June 2004 RI Update Memo.

In the SSL calculations, dermal exposure was taken into account only for arsenic and cadmium. Although a chemical-specific or default gastro-intestinal absorption factor is available for all of the COPCs in the final dermal guidance document, allowing for the derivation of dermal toxicity values for all substances for which an oral toxicity value is available, a chemical-specific dermal absorption factor is still only available for arsenic and cadmium (EPA does not recommend a default dermal absorption factor for inorganics). In the absence of a dermal absorption factor for a chemical, the dermal exposure route cannot be incorporated into the calculation of the SSL for that chemical. The gastro-intestinal and dermal absorption factors for arsenic and cadmium presented in the final dermal guidance are the same as those used in the June 2004 RI Update Memo SSL calculations.

In summary, outside of the soil adherence factor for the utility worker, there is no additional information presented in the revised dermal guidance that affects the SSL calculations.

39. Section 4, Table 4-5

Cancer Slope Factors (CSFs) and Unit Risk Factors (URFs). Toxicity criteria for elemental phosphorus was not provided on this table. This comment also applies to Table 4-6, Chronic Reference Doses (RFDs) and References Concentrations (RFCs). The tables must be revised accordingly.

<u>FMC Response:</u>

While the structure of Table 4-6 has been revised, no changes to the characterization of elemental phosphorus toxicity within either Table 4-5 or Table 4-6 are necessary.

Cancer slope factors (CSFs) and Unit Risk Factors (URFs) are developed for constituents for which sufficient data are available to conclude that exposure may result in an increased potential for carcinogenic health effects. As discussed in the text, only those chemicals classified by EPA as a known or potential human carcinogen (Group A, B, or C) are included in Table 4-5. EPA has classified elemental phosphorus (as white phosphorous) in Group D (not classifiable as to human carcinogenicity based on no data in humans and animals). Consequently, elemental phosphorus is not included within Table 4-5.

With respect to characterizing potential non-cancer health effects associated with chronic exposure to elemental phosphorus, both an oral reference dose (RfD) and an inhalation reference concentration (RfC) are presented in Table 4-6. However, the table has been revised to present the chronic toxicity factors for each COPC in alphabetical order. "Phosphorus (elemental)" appears after nickel and before selenium in the revised version of Table 4-6.

40. Section 4, Table 4-9

Since the QCwind values were derived using regional-specific climatic parameters, the PEF must be calculated using regional-specific climatic parameters.

The rationale for assuming that the site area is 50 acres must be provided (e.g., mean size of the source area).

FMC Response:

Outside of the QC_{wind} parameter, the particulate emission factor (PEF) is a function of the fraction of vegetative cover at the site (V), the mean annual wind speed at the site (U_m), the equivalent threshold value of wind speed at a height of 7 m (U_t), and a function dependent upon both U_m and U_t. Of these latter four parameters, only the mean annual wind speed (U_m) is a climatic parameter. In accordance with the comment, this parameter is characterized in the December 2004 RI Update Memo by the regional-specific mean annual wind speed for Pocatello, ID (4.6 m/s), as cited in Table 4-1 of Cowherd et al. (1985).

With respect to the site area assumed in the PEF-related calculations, it is considered most likely that any future commercial/industrial redevelopment on the FMC plant OU will be concentrated around existing infrastructure (e.g., railroad line), and be limited in size. However, to ensure conservatism in the assessment, the size of the largest RU not already slated for capping (RU 20 ~ 57.1 acres) was used as the basis for selecting a 50-acre source area in calculating the fugitive dust emission factor. This explanation has been incorporated into the December 2004 RI Update Memo.

While unfeasibly large, it should be noted that an assumed site area of 500 acres (i.e., the maximum allowable in the default EPA SSL equation) would result in no substantive changes to the findings of the RI Update Memo. The SSLs for most constituents would remain essentially unchanged because the contribution of the fugitive dust inhalation pathway to the final SSL for most COPCs is negligible. The SSLs for the maximally affected constituents (beryllium, cobalt, manganese and nickel) would be approximately 25% lower than the levels projected in the RI Update Memo. However, none of these SSLs would be exceeded by any of the historical data collected at the FMC Plant OU.

41. Section 4, Table 4-12

Table 4-12 incorrectly lists the oral RfD for elemental phosphorous as 0.0002 (mg/kg-day), based on ATSDR. The correct value is 0.00002 (mg/kg-day) based on IRIS, the preferred source for CERCLA toxicity values (U.S. Environmental Protection Agency, 1993b; Cook, 2003).

The oral RfD for uranium is incorrectly listed as 0.002 mg/kg-day. The table must be revised with the correct value of 0.0006 mg/kg-day (U.S. Environmental Protection Agency, 2000b; a).

FMC Response:

The values listed in Table 4-12 are subchronic RfDs and RfCs, intended to evaluate shorter-term (i.e., subchronic) exposures. As discussed in the text, the preferential sources of subchronic toxicity values were PPRTVs (EPA), HEAST (EPA), and ATSDR Minimal Risk Levels (MRLs). The hierarchy is generally in accordance with EPA guidance for developing soil screening levels for subchronic exposures (EPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response. OSWER 9355.4-24). IRIS does not develop subchronic toxicity values; the values listed in IRIS are chronic toxicity values intended to evaluate long-term exposures. Only if a subchronic value was not available, was a chronic toxicity value used, by default, to characterize subchronic exposure to a chemical.

Subchronic toxicity values (i.e., intermediate MRLs developed by ATSDR for the evaluation of exposures >14-364 days) were available for both elemental phosphorus and uranium. Therefore, these values were used as the subchronic toxicity values for these chemicals in preference to available chronic RfDs. The IRIS RfD for phosphorus and the Federal Register RfD for uranium are both chronic RfDs.

42. Section 4, Table 4-13

Assumptions used in the default particulate emission factor (PEF) equation for fugitive dust generation from wind blown soil should be evaluated. Specifically, the vegetative cover and the threshold value for wind may not be protective at FMC. The default fraction for vegetative cover is 50%. This default is not appropriate for much of the facility area.

Parameter Values Used to Calculate the Subchronic PEF for the construction worker exposed to fugitive dust generated by unpaved road must be reassessed. For a number of parameters listed on this table, FMC cites assumptions within the Supplemental Soil Screening Guidance, Appendix E, Case Example but did not explain or provide a rationale for the application of these assumptions to the FMC facility. A discussion regarding the assumptions and the associated uncertainties must be included.

FMC Response:

Revisions to address this comment have been made in the December 2004 RI Update Memo, as detailed below. The 50% vegetative cover (V) assumption and the equivalent threshold value of wind speed at 7 m (U_t) parameters are not relevant to Table 4-13, which is specific to estimating construction worker exposure to fugitive dust generated by unpaved road traffic. Instead, the V and U_t parameters are relevant to commercial/industrial worker exposure to wind generated fugitive dust (Table 4-9). Nonetheless, the EPA default assumption of 50% vegetative cover for evaluating commercial/industrial worker exposure to wind generated fugitive dust has been revised to 0% to reflect the fact that much of developed FMC Plant OU area is not vegetated. By contrast, the EPA default equivalent threshold value of wind speed at 7 m (U_t) used in the June 2004 RI Update Memo calculations is considered highly conservative (i.e., protective) for the FMC site, and has not been altered. The technical rationale for this conclusion is provided in the December 2004 RI Update Memo.

With respect to the parameter values used to calculate the subchronic PEF for the construction worker exposed to fugitive dust generated by unpaved road construction traffic, site-specific measurements are not available to characterize many of the parameters within EPA's default construction-related SSL equations (which were also assumed to apply to a utility worker). In the absence of such information, the assumptions within the Case Example presented within Appendix E of EPA's Supplemental Soil Screening Guidance were used to characterize the parameters. These values were used because, upon review, they appeared to either reasonably characterize or potentially overestimate the degree to which construction and utility-related work would result in fugitive dust emissions. Another factor considered in the selection of these values is the fact that EPA typically incorporates conservative (i.e., health protective) assumptions into its analyses. However, in accordance with the comment, parameter values used to calculate the subchronic PEF for the construction worker exposed to fugitive dust generated by unpaved road traffic have been reassessed based on available site-specific data. Moreover, FMC has incorporated further discussion in the December 2004 RI Update Memo regarding the basis for the use of site-specific or EPA Case Example assumptions to characterize the parameters used to derive construction and utility worker SSLs. In addition, potential uncertainties associated with making these assumptions are discussed.

43. Section 5, Ecological Risk Assessment Comments

The derivation of toxicity reference values for use in the screening evaluation of risks to terrestrial plants requires further clarification. There is a high uncertainty in using soil pore water estimations and soil solution TRVs as proposed in the RI Update Memo. The risks to plants should be assessed using bulk soil values. This analysis could be supplemented with soil pore water estimations and soil solution TRVs.

FMC Response:

For three of the COPCs (cadmium, fluoride and zinc) in the draft RI Update Memorandum, neither soil solution nor bulk soil concentration TRVs were developed to assess potential affects to terrestrial plants. Plant tissue-based TRVs were used because of the availability of plant tissue concentrations for these three constituents from the Bannock Hills SW RI ecological sampling station. This approach to evaluating potential cadmium, fluoride and zinc impacts to plants, which was also adopted in the Baseline ERA, was made feasible by the plant tissue sampling and analyses performed per the EPA-approved Baseline ERA work plan. The approach eliminates uncertainties associated with plant uptake from soil and soil solution, particularly as it is influenced by soil geochemistry. Because vanadium and chromium were not COPCs during the Baseline ERA, their concentrations were not analyzed in sampled plant tissue. To perform the screening level ERA for the undeveloped portions of the FMC Plant OU, vanadium and chromium phytotoxicity had to be evaluated via the use of either the bulk soil or soil pore-water plant TRVs contained within Efroymson et al. (1997).

Efroymson et al. (1997) gives a low confidence level to the bulk soil toxicological benchmarks for chromium and vanadium. The soil pore-water TRVs were given a moderate confidence level for chromium and a low confidence level for vanadium. (Note that Table 5-5b of the June 2004 RI Update Memo erroneously reported a low confidence level for the pore-water TRV for chromium.) The high degree of uncertainty associated with use of the bulk soil plant TRVs is further highlighted by the fact that the Efroymson et al. (1997) chromium and vanadium bulk soil TRVs are both more than twenty-fold lower than background chromium and vanadium levels in the EMF study area. As stated in Efroymson et al. (1997), "...if a benchmark is exceeded by background soil concentrations, it is generally safe to assume that the benchmark is a poor measure of risk to the plant community at that site". Consequently, while the reviewer suggests that there is a high uncertainty in using soil pore water based screening benchmarks, Efroymson et al. (1997) concludes that the bulk soils TRVs would not be appropriate indicators of risk since they exceed background concentrations for the area.

The non-applicability of the Efroymson et al. (1997) bulk soil TRVs to the FMC Plant OU is a result of the local soil geochemistry, e.g. high pH and mineral content generally associated with arid west soils, that tends to limit the dissolution and bioavailability of metals. In recognition of the influence of local soil geochemistry on metal bioavailability, EPA specifically requested in their July 2003 document entitled "Recommendations for Terrestrial Ecological Risk Assessment Activities Regarding the FMC OU" that "FMC derive TRVs applicable to arid west systems and screen these against measured or estimated concentrations in the south and west ecological areas of the FMC OU". Indicative of the emphasis of geochemical determinants on bioavailability, Efroymson et al. (1997) note that "the presence of soil in test systems reduces the experimenter's degree of control over exposure" and that plant exposure is via soil pore-water. Therefore, particularly in the absence of bulk soil TRVs developed in similar soil types, use of pore-water TRVs is considered best suited to ascertaining potential risks to terrestrial plants since modeled pore-water concentrations provide the means to incorporate values for local geochemical parameters, e.g. pH.

Since the June 2004 RI Update Memorandum, FMC has undertaken an extensive search in the primary literature to determine whether bulk soil toxicity data are available for a similar soil type as present at the FMC Plant OU. While inadequate information was available for vanadium, several chromium III bulk soil toxicity studies, the predominant form of chromium at the FMC Plant OU (see response to comment #44), were found to have been performed in high pH soils similar to those of the EMF area.

In a study using native soils in China at a pH of 7.98-8.25, slightly higher than those of regional soils (EMF average pH is 7.8 based on ten soil samples [E&E, 1995]), no apparent toxicity or effects on biomass were observed in wheat seedlings at chromium III soil concentrations of up to approximately 216 mg/kg, the maximum measured soil concentration (Ma et al., 2003). In another study, no changes in biomass were observed in Indian mustard and sunflower seedling plants at a chromium III soil concentration of 100 mg/kg; at a soil concentration of 300 mg/kg, biomass was decreased by approximately 35% and 45% in mustard and sunflower, respectively

(Shahandeh and Hossner, 2000). In a third study, a slight effect on biomass (approximately 15%) was observed when chromium III was added to soil (pH 7-8) at a concentration of 300 mg/kg (lowest concentration tested) (Bolan and Thiagarajan, 2001). These studies therefore confirm that no negative effect on the local plant population would be expected at the soil concentration of 76 mg/kg, the 95% UCL chromium concentration used to characterize the undeveloped portions of the FMC Plant OU, because of the high alkalinity of the local soils. Consequently, the use of the Efroymson et al. (1997) 1 mg/kg bulk soil TRV for chromium would be inappropriate for characterizing the potential toxicity of chromium at the FMC Plant OU. The pore-water approach to defining plant TRVs is therefore considered to be most suited to a determination of potential risks associated with the alkaline arid soils of the study area.

In summary, the soil pore-water TRVs for vanadium and chromium were developed to be representative of potential plant toxicity in the soils of the arid west, per EPA's recommendations. Furthermore, adopting a non site-specific bulk soil TRV would not eliminate uncertainty, but would rather add to the uncertainty since it would not address the significant influence that soil geochemistry has on the bioavailability of inorganics. Furthermore, as recommended by Efroymson et al. (1997), because background soil levels of vanadium and chromium are significantly lower that the benchmark (by 20-fold), the bulk soil TRVs are considered poor measures of risk. An intensive search for more recent data regarding bulk soil TRVs confirmed that the Efroymson et al. (1997) bulk soil TRV for chromium is at least two orders of magnitude too low in comparison to studies performed in soils of a similar pH to those of the study area. Consequently, the plant pore-water TRVs for vanadium and chromium, which are associated with either equal or higher confidence limits in comparison to the bulk soil TRVs, are the appropriate values to be used in the evaluation of potential impacts to terrestrial plants of the study area; the approach used in the June 2004 RI Update Memorandum did not require revision.

44. Section 5, Table 5-12

Provide the justification for sampling for total chromium rather than for Cr^{3+} and Cr^{6+}.

<u>FMC Response:</u>

During the EMF RI analyses were performed to evaluate the proportion of Cr(VI) in FMC process emissions. Appendix C of the Human Health Risk Assessment (HHRA) and Appendix AK of the RI report state that the most reliable data indicate that Cr(VI) accounts for less than 1% of the total chromium in historical air emissions from processes at the FMC plant that had the greatest potential to favor chromium oxidation. Furthermore, Cr(VI) is a strong oxidizing agent and tends to be reduced to Cr(III) in the environment as a result of reactions with organic matter and some inorganic chemicals such as iron and sulfides. Consequently, as indicated by the evaluation in the RI report, it is likely that a significant portion of any Cr(VI) historically released from the FMC facility has subsequently been reduced to Cr(III) within FMC Plant OU soils. In summary, total chromium and Cr(III) concentrations are nearly equivalent. Consequently, collection of speciated chromium data was considered unnecessary during the RI, as remains the case today.

45. Section 5.3, Page 5-2

Although the text states that EPA approved the use of specific data reported in the 1996 RI as surrogate data to represent the undeveloped southern and western portions of the FMC OU, the use of those data entails a high level of uncertainty, and the data may not be appropriate as surrogate. The primary rationale for use of the Bannock Hills SW data on plant and small mammal tissues as surrogate for data from the FMC OU was based on a comparison of soil data in the Bannock Hills SW with soil data collected at stations off-site but immediately adjacent to the undeveloped areas. However, review of the station locations in Figure 5-1, and the data in Table 5-2, leaves substantial uncertainty as to the appropriateness of that comparison. The off-site data are from five stations, but only two of which (Stations 225-2A and 225-2B) are adjacent to the undeveloped areas and in line with the predominant source of contaminant transport. The data in Table 5-2 suggest that only Stations 225-2A and 225-2B are contaminated with metals; the other three stations are not properly located to be surrogates, and their metals concentrations are closer to background levels. These considerations suggest that only the two stations at 225 would be appropriate surrogates for the undeveloped areas. The reliance on data from only two stations does not follow recommendations in EPA guidance for the number of samples to evaluate risks to terrestrial receptors at Superfund sites. The risks, based on the maximum values, must be calculated and presented in an uncertainty assessment.

FMC Response:

This comment appears to be based only on the limited discussion of the data provided in the June 2004 RI Update Memorandum, suggesting that the reviewer may not have been aware of FMC's *Evaluation of Potential Ecological Risks Within the FMC OU* "white paper", which included a detailed evaluation of the adequacy of off-site RI data to characterize conditions within the undeveloped areas of the FMC Plant OU. Furthermore, the remark, 'Although the text states that EPA approved the use of specific data", appears to have been written without knowledge of EPA's follow-up recommendations to the white paper, which indicated that the only outstanding issues to be evaluated in the RI Update Memorandum were related to updating the TRVs for cadmium, zinc and fluoride and the addition of vanadium and chromium as COPCs. Moreover, EPA specifically agreed in the final SOW that data collected at the Bannock Hills SW sampling station be used to evaluate potential on-site ecological risks for cadmium, fluoride and zinc. This was in large measure due to the findings of FMC's analysis of the RI surface soil data associated with samples collected along the 225 degree radial from the EMF facilities, which indicated that the maximum concentrations associated with deposition of historical emissions were located in the vicinity of the Bannock Hills SW sampling station. EPA also indicated that the RI data collected adjacent to the undeveloped areas, as identified in the white paper, could be used to estimate exposures and evaluate potential on-site ecological risks associated with chromium and vanadium. These Agency agreements were embodied into the scope of the ecological assessment task presented in the final SOW for the Supplemental RI/FS.

FMC also does not agree with the reviewer's technical basis for critiquing the use of all five adjacent off-site RI surface soil data points to characterize the chromium and vanadium exposure point concentrations carried forward into the ecological assessment of the undeveloped southern and western portions of the FMC Plant OU. The suggested use of the maximum off-site concentration to characterize conditions on over 500 acres of undeveloped land on the FMC

Plant OU is unrealistically conservative. This conclusion is supported by figures within the RI report that depict vanadium and chromium surface soil concentration isopleths.

Figure 5-2 of the December 2004 RI Update Memorandum (amended RI Figure 4.3-23) shows that vanadium surface soil concentrations within much of the undeveloped areas of the FMC Plant OU are likely below the regional background level (45.4 mg/kg) derived by EPA during the RI. As also shown in Figure 5-2, while portions of the undeveloped areas located adjacent to disturbed areas (e.g., slag pile) may exhibit higher levels, none are likely to exceed background by more than a factor of two. Similarly, as shown in Figure 5-3 of the December 2004 RI Update Memorandum (amended RI Figure 4.3-20), the undeveloped areas of the FMC Plant OU are likely to contain chromium ranging from below background (27.5 mg/kg) to approximately two-times this level at locations adjacent to disturbed areas of the FMC Plant OU. Therefore, the 95% UCL of the adjacent, offsite RI samples, several of which (i.e., Stations 225A and 225B) are located near historic fugitive sources that only affect a limited portion of the undeveloped areas, are likely to overestimate exposures across the entire undeveloped portions of the FMC Plant OU.

In summary, FMC believes that all five of the off-site RI data points located immediately adjacent to the undeveloped areas are highly relevant to the characterization of potential chromium and vanadium exposures. Moreover, use of the 95% UCL on the mean of these data points to characterize potential exposures is consistent with EPA guidance and likely results in a conservative (i.e., health protective) estimate of potential risks. Nonetheless, chromium and vanadium ecological risks estimated using only the maximum adjacent RI surface soil concentrations are presented and discussed within the uncertainty section of the December 2004 RI Update Memorandum. This effort was not extended to cadmium, fluoride and zinc which, consistent with the Baseline ERA, are most appropriately (and conservatively) characterized by the Bannock Hills SW data.

46. Section 5.4.1, Page 5-4

Although air emissions are no longer a source of contamination to the undeveloped portions of the OU from the FMC facility, the adjacent Simplot facility continues to act as an air emission source. In addition, air transport of fugitive dusts from contaminated soils and subsequent deposition onto soil and above-ground vegetation is also a relevant transport pathway. Consequently, exposure to COPCs transported in air, and deposited onto soil and plants, by ingestion of soil and plants are relevant exposure pathways and must be included in the conceptual site model.

<u>FMC Response:</u>

Section 5.4 presents the sources and potential exposure pathways that were identified in the Conceptual Site Model developed in the Baseline ERA. Because the CSM from the Baseline ERA is not directly relevant to the current assessment, it will not be updated to identify exposure pathways related to potential fugitive dust emissions on the FMC Plant OU. The text in Section 5.4.1 identifies the potential sources and receiving media evaluated in the current assessment of potential ecological risks within undeveloped areas of the FMC Plant OU. This text will be

modified to reflect the fact that fugitive dust emissions could potentially contribute to aboveground vegetative concentrations.

It should be noted that this comment does not affect the findings of the ecological assessment. The Bannock Hills SW unwashed vegetation data used in the current assessment accounted for both the deposition of process emissions from the FMC and Simplot facilities and fugitive dust deposition. Since FMC process emissions ceased in 2001, these data likely overestimate current plant concentrations of cadmium, fluoride, and zinc. However, a qualifying statement has been added to note that deposition of ongoing Simplot facility and fugitive dust emissions onto soil and aboveground vegetation may result in exposure to chromium and vanadium plant concentrations greater than those modeled through uptake alone.

47. Section 5.5, Page 5-5

The sources cited for the toxicity benchmarks are not primary sources but secondary sources. None of the sources listed provides original research to develop a toxicity benchmark, but instead are compilations of data from other publications that are subsequently used to develop benchmarks. In addition, the citation of Kabata-Pendias and Pendias, 2000 is incorrect. The correct citation is either Kabata-Pendias and Pendias, 1984, or Kabata-Pendias, 2000. The text must be revised to identify the secondary sources and to include the correct citation.

<u>FMC Response:</u>

The RI Update Memo will be amended to acknowledge that the cited toxicity benchmarks are from secondary sources that provide compilations of data from primary publications.

The correct reference is Kabata-Pendias, 2000, and is the 3rd edition of the book. The text will be revised to include the correct citation.

48. Section 5.5.1, Page 5-5, and Table 5-5a

The development of toxicity reference values (TRVs) for exposure of terrestrial plants to cadmium, fluoride and zinc is described for two types of TRVs: for comparison with plant tissue COPCs and with concentrations of COPCs in soil solution. TRVs based on plant tissue concentrations are identified as being taken from Kabata-Pendias and Pendias, 2000 (see above Specific Comment #48 regarding the incorrect citation). In general, critical values are provided for concentrations of chemicals in soil, not in plant tissue. Provide confirmation that the TRVs selected from the reference source are for application to plant tissue concentrations and not to soil concentrations. The TRVs selected are very similar to soil-based toxicity benchmarks compiled in Efroymson et al. 1997 for terrestrial plants, which brings into question whether the TRVs selected from the reference source are applicable to soil or to plant tissue. Because of the uncertainty with this method, the risk evaluation for terrestrial plant exposure to cadmium, fluoride, and zinc must also be performed by comparison of concentrations in bulk soil with the soil benchmarks provided in Efroymson et al. 1997.

FMC Response:

No revisions have been made to the December 2004 RI Update Memorandum. FMC does not believe that comparing bulk soil cadmium, fluoride and zinc concentrations to soil benchmarks provided in Efroymson et al. (1997) would reduce uncertainties in the assessment of potential effects to terrestrial plants. In fact, use of bulk soil benchmarks would considerably increase the degree of uncertainty compared to previous EPA and FMC evaluations. Furthermore, use of the Efroymson et al. (1997) bulk soil benchmarks is not technically justified based on a comparison to background soil concentrations. Specifically, the background soil concentrations for four of the five COPCs exceed the bulk soil benchmarks reported in Efroymson et al. (1997). In the case of vanadium and chromium, bulk soil benchmarks are more than 20-fold lower than the background concentrations. Additionally, the Efroymson et al. (1997) benchmarks are lower than the background soil concentrations for fluoride and zinc by nearly 50% and 85%, respectively. As noted in the response to Comment #43, Efroymson et al. (1997) considers bulk soil benchmarks to be poor measures of risk when background soil concentrations are higher than the benchmarks.

As described in the response to Comment #43, the potential for adverse effects to result from exposure of terrestrial plants to cadmium, fluoride, and zinc was evaluated by comparing measured plant tissue concentrations at the Baseline ERA Bannock Hills SW sampling station to plant tissue-based TRVs for these three constituents. Thus, contrary to the comment, soil pore-water TRVs were not developed to evaluate potential effects to terrestrial plants associated with cadmium, fluoride, and zinc exposure. Instead, this latter approach was restricted to the evaluation of chromium and vanadium, for which no plant tissue data were collected at the Baseline ERA Bannock Hills SW sampling station.

Plant tissue concentration-based TRVs for cadmium, fluoride, and zinc were obtained from Table 36 of Kabata-Pendias (2000). Plant tissue-based TRVs, rather than bulk soil or soil pore-water TRVs, were used to evaluate potential effects to terrestrial plants for cadmium, fluoride and zinc because this approach involves the direct comparison of measured plant tissue concentrations in sagebrush and thickspike wheatgrass to plant tissue concentration benchmarks known to cause toxic effects. Because soil chemistry plays a significant role in determining the extent to which chemicals (particularly inorganics) are taken up by plants, use of bulk soil benchmarks would be unjustified as stated by Efroymson et al. (1997). Moreover, the adopted approach (i.e., use of plant tissue-based TRVs) is identical to that used by EPA's contractor in performing the Baseline ERA of terrestrial habitats in the EMF study area.

49. Section 5.5.1, Page 5-5, and Table 5-5b.

The risk evaluation for terrestrial plant exposure to chromium and vanadium should be performed by comparison of concentrations in bulk soil with the soil benchmarks provided in Efroymson et al. 1997.

FMC Response:

See response to Comment #43.

50. Section 5.5, Page 5-5

The discussion of the development of TRVs for wildlife should come under a new subsection heading of 5.5.2.

FMC Response:

Agreed. The RI Update memo has been revised in accordance with this comment.

51. Section 5.5, Pages 5-5 & 5-6 and Table 5-8

The derivation of benchmarks for wildlife includes the extrapolation from laboratory test species to the assessment receptors. The method for the extrapolation is shown in Equation 5-1 and the basis is cited as Opresko et al. 1994. The updated compilation of wildlife toxicity benchmarks by Opresko (found in Sample et al. 1996) uses a different version of the equation. The extrapolations should have been based on the updated equation. However, Sample et al. (1996) also points out the high uncertainty in such an extrapolation, and essentially dissuades readers from using the extrapolation procedure. Sample et al. (1996) illustrates the high uncertainty with the procedure by showing that the smaller the receptor in comparison with the test species, the higher the toxicity benchmark will be, which would appear to indicate less toxicity of the chemical on a body weight basis. However, comparison of laboratory toxicity data for mice and rats in Sample et al. (1996) shows that a given chemical is not necessarily less toxic to smaller animals, and can be of greater, not lesser, toxicity on a body weight basis. For this reason, the TRVs must be derived without the extrapolation (i.e., without the scaling factors listed in Table 5-8), using the values and general approach in Sample et al. (1996). The ecological risk must be calculated without the use of scaling factors and be presented in an uncertainty sections.

FMC Response:

While it is recognized that some methods will change with the passage of time, the scaling methodology has not been called out as a concern in previous Agency comments that were drafted post-publication of the Sample et al. (1996) article. During the April 20, 2004 meeting at which the ecological risk assessment approach was presented, FMC indicated that this wildlife TRV extrapolation methodology would be employed to retain consistency with the Baseline ERA. Nonetheless, FMC recognizes that any method of extrapolating toxicity benchmarks developed for laboratory test species to assessment receptors has inherent uncertainties. Similarly, not extrapolating the benchmarks also has inherent uncertainties. Within the uncertainty section of the December 2004 RI Update Memo, a discussion of the extrapolation uncertainties has been added, including an estimation of risks without scaling the benchmarks to adjust for size differences amongst the species.

However, FMC disputes EPA's conclusion that Sample et al. (1996) dissuades readers from using any extrapolation procedure. In fact, in a more recent manuscript by the same main author (Sample and Arenal 1999), Sample summarizes his 1996 manuscript as having recommended an extrapolation procedure using a scaling factor (the power to which body weight is scaled) of 0.25 for mammals, although the scaling factor recommended for birds was zero. Additionally, in the Sample and Arenal manuscript (1999), analysis of acute toxicity data across all chemical classes led the authors to recommend scaling factors of -0.2 for birds and 0.06 for mammals, which have subsequently been used to evaluate chronic wildlife risks (e.g., Sample and Suter, [2002]).

Furthermore, Sample and Arenal (1999) suggest utilizing their chemical class-specific results where appropriate. An analysis of the inorganic data contained in Table 1 of their manuscript would result in scaling factors of 0.05 for birds and 0.2 for mammals. Potential risks associated with these chemical class-specific scaling factors are evaluated in the uncertainty section of Section 5 of the December 2004 RI Update Memo. Finally, it is important to note that per Table 2 of Sample and Arenal (1999) the mammalian and avian scaling factors derived for the majority of the chemicals evaluated are not statistically significantly different from the scaling factor used in the Baseline ERA.

52. Section 5.6.2, Page 5-9, Wildlife EPCs for Vanadium and Chromium, 3rd Equation

The term BCF_s should be revised to BCF_f, since it is the food-to-deer mouse bioconcentration factor.

FMC Response:

Agreed. The RI Update memo has been revised in accordance with this comment.

53. Section 5.6.2, Table 5-11

The source of the exposure point concentrations in soil, plants, and small mammals is identified as Table 4-3 of the baseline ERA. Although the text states that these are 95 upper confidence limits (UCL) on the mean, Table 4-3 does not state the statistical basis of the values. A reference to the calculation of the 95 UCL must be provided.

FMC Response:

As discussed within Section 4.3.1.2 and noted in Table 4-3 of the BERA, the 95% UCL on the arithmetic mean was used to characterize cadmium, fluoride and zinc exposure point concentrations in soil, plants, and small mammals, with the following exceptions:

Cadmium

Sagebrush (unwashed); background location – Non-outlier maximum concentration

Thickspike wheatgrass; background location – Average of detected concentrations

Fluoride

Thickspike wheatgrass; background location – One-half detection limit

Thickspike wheatgrass; undeveloped areas of FMC OU – Third quartile (75th percentile)

Deer mouse (whole body); background location – One-half detection limit

Zinc

Sagebrush (unwashed); background location – 95% UCL of lognormal distribution

The text and table within the December 2004 RI Update Memo has been modified to reflect the above.

54. Section 5.6.2, Table 5-12

Only two stations (Stations 225A & B) should have been considered appropriate surrogates, and the exposure point concentrations derived in Table 5-12 should have been derived from those two stations as the maximum values. However, chemistry data from only two soil stations are insufficient to develop exposure point concentrations or to characterize risks to ecological terrestrial receptors. The RI Update Memo must be revised to a discussion of this in an uncertainty section.

FMC Response:

This comment has already been addressed in the response to Comment #45. In summary, while FMC does not concur with the conclusion that only Stations 225A and 225B are appropriate surrogates, the uncertainty section has been revised to include a recharacterization of potential chromium and vanadium risks using only the maximum concentrations from the off-site RI surface soil samples collected from areas adjacent to the undeveloped portions of the FMC Plant OU. This effort has not been extended to cadmium, fluoride and zinc, which, consistent with the BERA, are most appropriately and conservatively characterized by the Bannock Hills SW data.

55. Section 5, Table 5-17

The value for the soil pore water concentration for chromium in the undeveloped areas of the FMC OU should be expressed in scientific notation for the table to read properly.

FMC Response:

Agreed. The RI Update memo has been revised in accordance with this comment.

56. Section 5.7.1 & Table 5-19

As discussed in Specific Comment #48, the derivation of the TRVs for cadmium, fluoride, and zinc needs further explanation to ensure that they are correctly applicable as tissue-based values. The exposure estimate (EE) values for chromium and vanadium are in units of mg/L, not mg/kg, as are the TRVs derived for those metals. The table must be revised by adding a footnote that these values are calculated for soil pore-water and used for soil solution.

FMC Response:

As discussed in FMC's response to Specific Comment #48, the cadmium, fluoride, and zinc TRVs are plant tissue-based values obtained from Table 36 of Kabata-Pendias (2000).

The comment correctly states that the EE and TRV values for chromium and vanadium in Table 5-19 should be identified as being in units of mg/L, not mg/kg. The table has been corrected and a footnote added as suggested.

57. Section 5.7.1 & Table 5-20

Risk calculations must be recomputed for TRVs that are expressed per body weight but derived without extrapolation. Of specific concern are the TRVs for receptors smaller than the test species, including the deer mouse, Townsend's big-eared bat, and horned lark. For those species, TRVs may have been overestimated, with consequent risks underestimated, possibly by factors of 2- to 3-fold for the deer mouse, 3-fold for the bat, and 3-fold for the horned lark. Corrections to the TRVs, and consequent HQs in Table 5-20, suggest that risks from vanadium could exceed HQ of 1 for the deer mouse and bat. The risk calculations must also be recomputed using the maximum EPC instead of the 95 UCL from the surrogate stations.

<u>FMC Response:</u>

Comments concerning the suitability of the off-site RI data used to characterize exposure point concentrations (i.e., 95% UCL on the mean versus maximum) were previously addressed (responses to Comment #s 45 and 54) from the perspective of how they contradict prior direction from EPA. These responses are not repeated here.

The remainder of the comment is similar in content to Comment # 51 above. The reviewer in this comment is, however, more specific in stating the concern that the vanadium TRVs may increase by 2 to 3-fold and, consequently, result in a risk potentially exceeding an HQ of one for some receptors.

With regard to the significance of the extrapolation approach on the risk assessment findings, it should be noted that a HQ above one does not specifically indicate potential risks. In fact, as was discussed for other COPCs elevated above one (some of which would be below one if the TRV extrapolation methodology was changed to that proposed by the reviewer), there was sufficient conservatism in the BERA methodology to suggest that there is only a marginal exceedance and that there are unlikely to be any population or community level effects. Moreover, due to the high degree of conservatism inherent within the evaluation of potential vanadium risks (as described in Section 5.7 of the RI Update Memorandum), it is unlikely that any individual receptor would experience an adverse health effect associated with exposure to this constituent.

FMC concludes that changing the TRV extrapolation approach and using the maximum rather than the 95% UCL on the mean concentration are both contrary to previous discussions and add little to the ecological risk assessment. Nonetheless, FMC has included in the uncertainty section a recharacterization of the risks estimated using the maximum concentrations from the adjacent areas (for chromium and vanadium only) as well as eliminating the TRV extrapolation that was performed to account for species differences.

58. Section 5.7.1, Page 5-12, Terrestrial HQs, 1st Paragraph

Comment #47 also applies to this section.

<u>FMC Response:</u>

The comment most likely should refer to Comment #46. FMC agrees that there remains the potential for re-suspended soils to deposit on vegetation. However, as discussed in the response to Comment #46, the degree to which contaminants within re-suspended soil particles are deposited on plant surfaces at this time is certainly lower than the extent to which contaminants were deposited on plant surfaces when the facility was operating and releasing air emissions prior to 2001.

Hence FMC's statement within the text indicating that use of cadmium, fluoride, and zinc data associated with unwashed vegetation samples "adds a measure of conservatism to the current assessment" is appropriate given that the FMC facility was still operational at the time that the unwashed samples were collected. However, as discussed in the response to Comment #46, a qualifying statement has been added to note that deposition of ongoing Simplot facility and fugitive dust emissions onto soil and aboveground vegetation may result in exposure to chromium and vanadium plant concentrations greater than those modeled through uptake alone.

59. Section 6 (Text and Tables), General Comment

Section 6 must be revised to identify COPCs for each RU. The COPCs for each RU must be added to Table 7-1.

<u>FMC Response:</u>

The December 2004 RI Update Memo has been revised and contains a listing of COCs and COPCs for each RU, based on data from the EMF RI, other data sources, and process knowledge. This information is provided in Table 6-1, at the beginning of Section 6 in the final RI Update Memo.

60. Section 6, Page 6-1, Step 1, State the Problem

The text must be amended to address the fact that previous investigations did not determine the nature and extent of radionuclide contamination at the FMC OU. This data gap affects the ability to make remedial decisions at some of the FMC RUs. Selection of appropriate COPCs is a necessary step in the DQO process. Previous comments recommending collection and analysis of individual radioactive uranium decay products are applicable to this section. Gamma readings, without concurrent individual radionuclide concentrations of surface and sub-surface materials, are insufficient to characterize site conditions to make "no further action" determinations (Luftig & Page, 1999).

<u>FMC Response:</u>

The EMF RI (BEI, 1996) characterized the nature of radionuclide activities in the various materials stored at the FMC Plant OU. Thirty-one samples of potential source material and 95 native soil samples within the FMC Plant OU were analyzed for radiological parameters during the course of the EMF RI. In addition, a gamma radiation survey of the FMC plant area was conducted as part of the EMF RI (see Appendix O-2 of the EMF RI Report).

However, FMC agrees that further characterization of the extent of radiological impact is warranted. Supplemental characterization of gamma radiation and lead-210 will be performed at RUs identified as candidates for no further action during the SRI, and all data collection will be subject to the DQO Process, as noted in the response to EPA Specific Comment 31. Please also see the responses to General Comments 3 and 4 and Specific Comment 30.

61. Section 6, Page 6-4, Step 6, 4th paragraph

Decision 4 Error is not complete in that the Δ value and the σ value are not specified. There must be a reference to Section 6.1.4 and the appropriate page number where the notion of Δ is discussed. In addition, the formula used for the calculation of the number of samples, n, needs to be specified along with the assumptions applicable to the formula in question.

FMC Response:

Regarding the discussion of Δ, this change will be made by adding a reference to Section 6.1.4. The appropriate formulae for calculating the number of samples are now included in the discussion of Step 6.

62. Section 6.1.1, Pages 6-5 & 6-6, RU 22b – Old Ponds & Figure 6-2

The RI Update Memo must be revised to propose additional investigation of the solid waste management units (SWMUs) within remediation unit (RU) 22b. Elemental phosphorus levels are a data gap and need to be assessed in order to proceed with cap design to ensure that the final cap will be protective of human health and the environment.

FMC Response:

Please refer to FMC's response to General Comment 6, regarding the issue of further characterization of SWMUs within RU 22b.

63. Section 6.1.1, Page 6-7, RU 8, 1st Paragraph, Last Sentence & Figure 6-8

This sentence states that the pond sediments are covered by concrete slabs as a result of calciner construction in the late 1960's. Please clarify in the text whether concrete slabs cover the entirety of the three former kiln scrubber ponds, or whether the concrete slabs are limited to the rectangular footprints shown in the middle and eastern ponds in Figure 6-8. The rectangles are not labeled on the figure, so it is unclear whether they are buildings.

FMC Response:

Figure 6-8 has been revised to show the pond footprints. The calciner foundations do not cover the entire extent of the former kiln scrubber ponds. Clarifying text has been added to the document.

64. Section 6.1.1, Page 6-8, RU 16, 4th Paragraph

Identify the "remediation vision" for this site that is referenced in this paragraph.

FMC Response:

In the discussion for each RU, the Remediation Vision will be reiterated in the introductory paragraphs. Specific to RU 16:

"The remediation vision for this RU is capping/soil cover to reduce the potential for direct exposure."

Please also see the proposed changes to text in section 6 submitted to EPA on September 7, 2004. This provides proposed changes to the text to address a data gap on the potential leachability of the calciner pond solids. These revisions are shown in Section 6.1.1, RU 16.

65. Section 6.1.1, Page 6-8, RU 16, 3rd paragraph

The referenced text states contaminants migrated to a depth of at least 10 feet beneath the pile. This is inconsistent with the description found in Table 6-9 which states *that "soil borings show very little if any migration of metals or other EMF-related constituents into native soils beneath the calciner solids."* Provide or reference the actual data (including sample depths and analytes).

FMC Response:

The RI Update Memo has been revised to reflect the history of RU 16 and any conclusions that can be drawn from the available data. The detailed discussion of the data and findings are provided in the EMF RI Report, page 4.2-164 and Table 4.2.3-33 (BEI, 1996). These pages of the EMF RI are cited in the text of the December 2004 RI Update Memo.

66. Section 6.1.1, Page 6-8, RU 16, 3rd Paragraph

The text states that soil data from stockpile borings show that some contaminants have migrated up to 10 feet into the soils beneath the pile. However, neither the text nor Table 6-9 identify the COPCs. Revise the text to provide this information.

FMC Response:

This information has been added at the beginning of Section 6 (see Table 6-1). Please also see response to Specific Comment 59 above.

67. Section 6, Figure 6-10

The text does not describe the differences between SWMU 17 (Storage Area B) and SWMU 1 (Calciner Solids Stockpile) identified in the figure. The text must be revised to describe SWMU 17. The existing data appears to have been taken from roadway areas. It is not clear this existing data adequately characterizes the unit. The results of samples collected in the roadways may not be representative of conditions found within the stockpile, where the source term (i.e., stockpile) is presumably thicker. The document must be revised to discuss the adequacy of the existing data for remedy selection.

The text must describe what is meant by *"above representative levels."* It is unclear if this is referring to background concentrations or some other criteria. See general comment #2.

FMC Response:

The RI Update Memo has been revised to reflect the historical use of RU 16. Please see the response to General Comment 2 and Specific Comment 66. Also see FMC's submittal to EPA dated September 7, 2004 and revisions found in Section 6.1.1, RU 16 of the December 2004 RI Update Memo.

68. Section 6.1.1, Page 6-8, RU 16

Provide a reference for the EMF RI table containing the analytical results for boring F160B. This information can not be located in existing files.

FMC Response:

Boring F160B was drilled to install a groundwater monitoring well. Bedrock was encountered at a depth of 107 feet, no groundwater was encountered in the boring, and the borehole was backfilled with cement grout. No soil samples were submitted for chemical analysis from this boring. A note has been added to the RU 16 map displaying boring F160B stating that no samples were collected and analyzed from this boring. Please see Appendix B of the EMF RI for the boring log.

69. Section 6.1.1, Page 6-8, RU 8, Last 2 Paragraphs in Section

The statement is made that the selected remedy of RU 16 *"could be effectively applied at RU 8."* It is unclear whether this indicates the intention to apply said remedy. The text must specify the remedial action anticipated for this site.

FMC Response:

As with all RU's, the remediation vision was stated in the accompanying summary figures. The December 2004 RI Update Memo includes a clear statement of the remediation vision for each RU in Section 6 text, as well as on the summary figures.

Specific to RU 8, FMC's remediation vision is to "Leave existing concrete slabs in-place, grade to design subgrade elevation and construct soil cover (cap) over entire footprint of these areas." This statement will be reiterated in the text discussing RU 8. Please see revised text in Section 6.1.1, RU 8.

70. Section 6.1.1, Pages 6-6 to 6-7, RU 22C, 1st Sentence in section

Based on this discussion, it appears that the liner required by the 1998 ROD has not been installed, and that the only liner present at this site was one installed over a portion of the swale in 1993. The lateral extent of the 1993 liner must be depicted on Figure 6-5. It is not possible to evaluate the results of the EMF RI soil borings without knowing where they were collected with respect to the existing liner. Additionally, the "Data Gaps" identified in Figure 6-4 states, *"Potential for P4 above the liner."* It is not possible to evaluate this statement about data gaps without the information regarding the locations of the existing liner and the previous EMF RI sample locations.

In addition, since FMC will no longer control use and access in the vicinity of the railroad swale, the remedy needs to be designed to ensure that the site does not pose a significant risk to future users of the site. Since the phos dock overflowed into this area, samples must be collected to determine the lateral and vertical extent of contamination and to characterize wastes present at the site. This information will be required to design a final cap that contains the waste and is protective.

FMC Response:

The liner extent will be illustrated on Figure 6-5, along with the storm drain outfall location (i.e., location where P4 was potentially introduced into the RR Swale.) Please see revised text in Section 6.1.1, RU 22c and new Figure 6-5a.

71. Section 6.1.1, Pages 6-7 to 6-8, RU 8, General Comment

Clarify in the text whether the kiln scrubber overflow pond and the ditch leading to it are considered part of RU 8 or RU 9. Figures 6-8 and 6-31 are confusing on this point. Based on process knowledge, the kiln scrubber overflow pond and ditch should be included in RU 8.

FMC Response:

Based on process knowledge and EMF RI data, it appears the kiln scrubber overflow pond and ditch were used for transporting/storing clarified kiln scrubber water. The kiln scrubber solids were deposited in the kiln scrubber ponds, so there is likely to be significantly less of an accumulation of kiln scrubber solids in RU 9. FMC's remediation vision for RU 8 is capping, while the remediation vision for RU 9 is no further action, pending the results of the SRI/SFS. Please see revised text in Section 6.1.1, RU 8 and Figure 6-8.

72. Section 6.1.1, Page 6-7, RU 8, Last Sentence in Section

Revise the text to discuss whether or not the silt aquifer overlying the uppermost aquifer has been shown to be laterally extensive, whether or not it is a horizontal aquitard or is sloped, and whether tests have been performed to determine the leakage factor.

In addition, since the precise location of the kiln scrubber ponds is not known, and because the levels of radionuclides and inorganics in the waste is not known, the RI Update Memo must be revised to indicate this is a data gap. To address this data gap samples should be collected to determine the lateral and vertical extent of contamination and to obtain data to be used for the cap design.

FMC Response:

The silt aquifer is laterally extensive, it is nearly horizontal in this area, and vertical permeability tests have been conducted on the silt aquitard overlying the shallow aquifer at the EMF Site. Please see Sections 3-3, 4-4, and Appendix K of the EMF RI for a more complete presentation of the site hydrogeologic characterization data. Section 6.1.1 (RU 8) discussion has been revised, and a reference to the appropriate sections of the EMF RI Report has been included in the document.

The location of the kiln scrubber ponds is well known and is shown in the 1965 air photo in Figure 6-8. Process knowledge and extensive characterization of calciner pond solids is sufficient for supporting decisions regarding the cap design for RU 8. FMC agrees that confirmation borings or trenching should be conducted along the exterior boundaries of the ponds, where accessible, to define the lateral extent of the cap. This is now recognized as a data gap in the discussion of RU 8.

Delineating the vertical distribution of the contaminants is not necessary when the data and process knowledge all indicate these former unlined ponds leaked to groundwater. The 1998 ROD selected a remedy for groundwater and the cap will reduce the potential for future contaminant loading to groundwater. The RI Update memo has not been revised to identify this issue as a data gap.

73. Section 6.1.2, Pages 6-9 & 6-10

The 44°C isotherm study should not be the only parameter considered in determining the migration of P4 and other contaminants at the various RUs. The potential value in the 44 °C Isotherm Study is that it could potentially help determine where soil sampling would begin as part of the effort to determine the lateral dimensions of the cap. The 44 °C Isotherm Study alone will not provide the necessary data to determine the dimensions of the cap.

While P4 may migrate due to the higher temperatures, other COPCs such as cadmium and arsenic, which have a higher solubility, could be distributed beyond the model boundaries identified for P4 and its oxidation product. A proposal to assess the distribution of metals that may have migrated beyond the model boundaries must be included. While the model may delineate the cap boundary, sampling must be conducted to ensure the lateral extent of the cap is sufficient to reduce infiltration and be protective of human health and the environment.

FMC Response:

The primary factors affecting the migration of P4 are the bulk thermal conductivity of the underlying porous media. This variable is influenced by soil moisture, permeability and porosity. All these variables will be investigated in the thermal modeling study.

Solubility and pH are not considered in the thermal modeling effort because these factors do not affect the thermal properties of the soils and will not affect the distribution of elemental phosphorus in the subsurface, particularly at the levels of interest for this study.

The solubility limit of elemental phosphorus is 3.0 mg/l, the RBC for elemental phosphorus is 22.7 mg/kg, while the concentration at which elemental phosphorus can smoke is 1,000 mg/kg. Given these figures, the solubility of P4 does not play a significant role in transporting elemental phosphorus in the subsurface when compared to heating the porous media above 44 C. In other words, where the soils were heated above 44 C, over 10% of the mass could be elemental phosphorus, assuming that one-half of the pore spaces are occupied by P4. Where soils are below 44 C, and fully saturated with water transporting dissolved elemental phosphorus, approximately 0.00006% of the mass could be elemental phosphorus (assumes 20% porosity of soil is occupied by water with 3 mg/l of P4).

The modeling effort will be used to assess metal transport in the vadose zone to determine if the lateral extent of transport of metals in the dissolved phase could significantly exceed the lateral distribution of the P4. Decisions for analyzing confirmation soil samples for metals will be made after reviewing the modeling results.

74. Section 6.1.2, Page 6-9, 4th Paragraph

It is premature to determine in this document whether the process piping in RU 1 and RU 2 should be removed. Information must be presented identifying the extent of subsurface piping in these RUs, the size and material of construction, depths of burial, and any process knowledge regarding the residuals expected to be remaining in the pipes. The RI Update Memo must be revised to include this information and identify any data gaps regarding the process piping.

FMC Response:

The RI Update Memo concluded that within RU 1 and RU 2 boundaries, subgrade piping will be emptied, plugged and abandoned in place. The envisioned cap will cover the subgrade piping within these RU boundaries. The discussion describes the conditions of RU 1 and RU 2 and all plant decommissioning work is completed. It presents a "starting point" for evaluating remedial alternatives under the SFS, and is also intended to aid in identifying potential data gaps to be addressed in the SRI.

For the subgrade piping that lies between RU 22b (Former Ponds), and the final cap extent at RU 2, the RI Update Memo does not draw a conclusion regarding removal of this piping. the RI Update Memo states:

"FMC will evaluate the feasibility of removing the subgrade piping in areas between the former P4 working areas and the old ponds in RU 22a and RU 22b. The underground P4 process piping outside of RU 1 and RU 2 is the only potential P4 source outside RU 1 and RU 2 (there are no process vessels outside these RU's). Any potential P4 releases from this piping would be immobile because the ambient soil temperatures along the pipeline route are below 44°C."

Any proposed actions to remove underground piping will be evaluated in the Supplemental Feasibility Study.

Underground piping in the RU 1 and RU 2 is primarily mild steel pipe, with diameters of 4 to 6 inches. These pipes carried phossy water and sludge to the ponds. Within RU 1 and RU 2, if there were leaks in these pipes, the heated soils may have allowed migration of P4 away from the leak. Therefore, removal of piping in RU 1 and RU 2 would pose a greater risk to site workers, and would only achieve removal of a small potential source of P4. Further away from the heat sources, the P4 would not migrate (soil temperatures would remain below 44°C near the piping), and in the area outside the RU 1 and RU 2 boundaries, FMC may be able to remove soils containing P4 concentrations above the RBCs.

No revisions to the RI Update Memo have been made to address this comment.

75. Section 6.1.2, Pages 6-9 & 6-10, 5th Paragraph, 1st Sentence

The document should clarify whether RU 1 and RU 2 are being addressed under CERCLA or RCRA authority. The first sentence is confusing regarding this point. Later in Section 6.1.2.1, the text appears to indicate that RU 2 is being addressed under RCRA. These sections should be revised to clarify the program authority.

FMC Response:

The RI Update Memo has been revised to clarify that RU 1 and RU 2 are being addressed under CERCLA. The Slag Pit Wastewater Collection Sump is a small RCRA WMU within the boundaries of RU 2, and FMC will close this unit under RCRA.

76. Section 6.1.2.1, Page 6-12, Existing Cover Assessment, 2nd Paragraph, Last Sentence

This paragraph describes building foundations with some unstated number of sumps (of unstated sizes) present, piping that is proposed to be cut and capped, and depressions that will be backfilled with some unstated material. The description provided does not suggest that the decommissioning activities will result in a *"monolithic slab of concrete surrounded by paved areas."* Instead, these activities suggest that the pre-RD site would have vastly differing hydraulic properties (e.g., concrete structures versus backfill), and the potential for conduits to channel infiltration (along process piping, and sumps filled with unspecified backfill materials). The document must be revised to describe the area. The text must be clarified. Additionally, information must be provided to support the statement that the concrete slab foundation is *"impermeable over large areas."*

FMC Response:

The text has been revised to describe the furnace building foundation after decommissioning activities are complete. The following text has been used:

> "The furnace building foundation is primarily a level concrete slab with below grade sumps and launders. After demolition of the superstructure is completed, the sumps and below grade features will be backfilled and the fill material will be graded to manage run-on/run-off and prevent water accumulation in these areas. Below grade piping will be plugged and abandoned in place. If capping is selected as the remedy, the concrete foundation will be integrated into the final contouring of RU 1 and RU 2 during the RD phase. Cap design will be RCRA-equivalent, and will not rely on the concrete slab to minimize infiltration."

77. Section 6.1.2.1, Page 6-12, *Existing Cover Assessment,* 1st Paragraph

Summarize in the text what closure activities are required by the closure plan, and where the closure plan is in the approval process. Providing this information will enable and facilitate the CERCLA efforts to be integrated efficiently.

FMC Response:

The Slag Pit Sump Closure Plan calls for construction of a RCRA cap over the slag pit sump area. The Closure Plan was submitted to EPA in September 2001, and FMC is awaiting EPA's approval. FMC will provide the appropriate cap design information for evaluating capping RU 1 and RU 2 in the SFS, and, assuming capping is selected as the remedy for RU 1 and RU 2, the detailed cap design will be developed during the RD/RA.

78. Section 6.1.2.1, Page 6-13, Statistical Comparison of Site Data with RBCs, 2nd Paragraph

An explanation of why only inorganic constituents were statistically analyzed is needed. A discussion of the data that are available for organic contaminants and statistical evaluation, if appropriate, should be included.

FMC Response:

There were no organic contaminants identified in the EMF RI and HHRA that were considered a COC or risk-driver in shallow soils. Therefore, these were not analyzed statistically.

Organic contaminants within the FMC Plant OU were discussed in the EMF RI, Section 4.2.3. SSLs for the organic compounds detected in shallow soils will be developed by FMC.

79. Section 6.1.2.1, Pages 6-14 & 6-15, RU 6 – Long-term Phos Storage Facilities, RU 6

The railroad track adjacent to the long-term phosphorus storage tanks (former) and the railcar loading overflow tank must be sampled for P4 as this is an area likely to have had operating units and releases occur. The RI Update Memo must be revised to identify this as a data gap and propose data collection to address.

FMC Response:

Agreed. FMC believes this was discussed in the June 2004 RI Update Memo in the "Data Gaps" summary for RU 6: "There is a potential that spills may have occurred during the loading and unloading of railcars with P4. Shallow soil samples near the spur line are needed to evaluate the potential for P4 in the 0-10' depth interval." No revisions have been made to the December 2004 RI Update Memo.

80. Section 6.1.3, Page 6-15, 2nd Paragraph, 4th Bullet

As discussed in Specific Comment #10, infiltration controls will be a necessary component of the landfill remedies. There is insufficient information regarding the source terms at RU 18 and RU 19 (former plant landfill or buried railcar areas) to conclude that these controls are not needed. In the absence of specific information regarding the nature of the wastes disposed, the presumptive remedy includes measures to minimize infiltration. Please revise the text to indicate that the presumptive remedy for sites RU18 and 19 will include the remedial action objective to minimize infiltration. As stated in previous comments, this may be achieved by the design and construction of an evapotranspirative cover, with an adequate infiltration storage layer.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004. The text now includes the remedial action objective for minimizing infiltration for RU 18 and the two areas of interest in RU 19 (Former Plant Landfill and buried sludge-containing railcars).

81. Section 6.1.3, Page 6-16, 2nd Paragraph, & Page 6-19, Technical Area 6

Although geotechnical data from a proposed borrow area are found in Appendix D, these raw data cannot be evaluated for suitability as cover material until we are provided with a cover design.

FMC Response:

Comment noted. Appendix D was provided for information only, and is not considered final design criteria for any covers/caps that FMC may install. The cover page for Appendix D reflects this.

82. Section 6.1.3, Page 6-17, Technical Area 1, 2nd Paragraph in Section, Last Sentence

The RI Update Memorandum must include more information regarding the types of materials that are being proposed for disposal at the area in between RU17 and 18. Information should include both the potential for contamination and the physical properties of the wastes in order to design an adequate cap. The waste zone must not have void spaces that could compromise the integrity of the final cover.

FMC Response:

FMC assumes that the comment refers to the type of materials being managed in the Recyclable Material Landfill (RU 17) and the Plant Landfill (RU 18). There are no waste disposal sites in the area "in between RU 17 and 18" as stated in the comment.

The materials managed in the Recyclable Material Landfill (RU 17) are described in Table 6-3 and in the description of SWMU 89 in Table A-17 in Appendix A of the RI Update Memo. FMC does not plan to add any additional materials to the Recyclable Material Landfill during facility decommissioning and demolition.

The materials managed in the Plant Landfill (RU 18) are described in Table 6-3 and in the description of SWMU 45 in Table A-18 in Appendix A of the RI Update Memo. The Plant Landfill will continue in use for management these types of nonhazardous wastes during facility decommissioning and demolition.

All the wastes managed in the landfills are nonhazardous and generated on-site. The landfill is managed to minimize void space and interim cover is applied periodically with a bulldozer or loader. These RCRA Subtitle D industrial landfills are not subject to permitting requirements. As noted in Section 6, FMC's remediation vision for RU 17 and RU 18 is to install a cover consistent with EPA's presumptive remedy guidelines for municipal landfills.

83. Section 6.1.3, Page 6-19, Technical Area 4, 3rd Paragraph in Section, Last Sentence

It is reasonable to assume that slag will become a component of the engineered covers. However, note that the covers over RU 18 and 19 must also minimize infiltration. The last sentence must be revised to read, "The final cover design will integrate the slag into the landfill cover and be designed to minimize infiltration through the waste."

FMC Response:

The RI Update Memo has been revised in accordance with the comment.

84. Section 6.1.4, Page 6-23, RU 20 – Former Bannock Paving Area

The source causing elevated nitrogen levels in monitoring well #139 must be identified.

FMC Response:

In the discussion of RU 20, FMC will add the following:

> "During the EMF RI, elevated levels of nitrate were detected in groundwater samples from Well 139, located approximately 450 feet west of the coke drying scrubber basin. The source of this nitrate was not confirmed during the EMF RI. Subsequently, a potential source has been identified. Wet coke was stockpiled in the area of Well 139 before the coke was dried and used in the elemental phosphorus production process. Coke production is a major source of ammonia sulfate, a fertilizer compound, and wet coke can contain a significant amount of ammonia because it has not been fully dried. The wet coke stockpile was not covered or lined, so precipitation could infiltrate the wet coke, oxidize and leach ammonia, and ultimately transport it to the uppermost aquifer. The Eh in the vadose zone would also allow mobilized ammonia to oxidize to nitrate as it was transported through the vadose zone."

The RI Update data gaps discussion for RU 20 now states that the residual coke characterization will include leachability testing for ammonia and nitrate to confirm the source of elevated nitrate in Well 139.

85. Section 6.1.4, 6-25, RU 5 – Lab and Old Drain Field

Additional VOC and semi-VOC samples must be collected to complete the characterization at this RU.

FMC Response:

The following text was improperly inserted in the discussion for RU 4. The RI Update Memo has been revised, and the following discussion will apply to RU 5:

> "Although the EMF RI did not identify the disposal area behind the lab as a potential source to groundwater, additional characterization is needed for VOCs and SVOCs in the shallow soils in order to reach a no further action decision or if the area should be evaluated in the SFS. If VOCs and/or SVOCs are detected, limited hotspot remediation will be evaluated in the SFS."

86. Section 6.1.4, Page 6-20, Methods, 2nd Paragraph, 4th Item

It is not appropriate to exclude site data indicating contamination has migrated below 10 feet. Even though there may be no current or future exposure risk pathway, the remedy may require measures to protect the aquifer from degradation consistent with USEPA's Groundwater Protection Strategy and Idaho's Groundwater Quality Rule. Therefore, all data must be included in the evaluation.

FMC Response:

As set forth in the SOW, the focus of the SRI is to delineate areas where surface and subsoils could potentially pose risks under future worker scenarios. Some utility work may occur to depths of 10 feet, therefore, this maximum depth was selected as the cut-off for the statistical analysis.

Deeper soils data and fate and transport of COPCs to groundwater were evaluated and results were presented in the EMF RI Report. The RI Update Memo was not intended to re-evaluate the fate and transport of COPCs in groundwater at the EMF Site.

87. Section 6.1.4, Page 6-20, Methods, 2nd Paragraph, 2nd Item

This item states that, *"there were no "R" flagged data in the dataset."* This statement is not correct. Tables C-14 and C-24 indicate R flagged data for thallium. The text should be revised to address this inconsistency.

FMC Response:

The commenter apparently misunderstood the context of the text referred to in the comment, which is a generic discussion of the methodology rather than a statement of fact. The entire description of this step states:

"Analytical data were also reviewed for data quality to determine:

1. The detection limits were lower than levels of concern (RBCs, background, etc.)
2. There were no "R" flagged data in the dataset, "R" = analytical results rejected during the QA process. The "R" flagged data were not used in the statistical analyses."

FMC believes the text is clear and that no revisions are necessary.

88. Section 6.1.4, Page 6-21, Methods Comments of Shapiro-Wilk Test & Nondetects

There are a number of constituents that have small data sets with greater than 15% nondetected values. For samples with nondetects, the normal distribution assumption is invalid and should be removed. The following tables indicate those RUs and constituents that have between 15% and 50% nondetects, and greater than 50% nondetects. Until a new data analysis related to censored data is performed, the conclusions regarding the comparison to action levels are not valid.

Constituents with between 15% and 50% censored data (U and UJ) in analysis:

RU	Site Worker RBC	Construction Worker RBC	Utility Worker RBC	Background
RU 1		Be, Se		
RU 4		As, Be	As, Be, Pb, Hg	As, Be, Pb, Hg
RU 7	Li, Se	B, Cd, Li	B, Cd	B, Cd
RU 9		Be, B, Co, Pb, Hg, Se,		Pb, Li
RU 12		B, Cd, Pb	Cd, Pb, Li	Cd, Cu, Pb
RU 13			B, Hg, Se	B, Hg, Se
RU 20	Se	B, Co, Ag	Co, Li	Co, Li

Constituents with > 50% censored data (U and UJ) in analysis:

RU	Site Worker RBC	Construction Worker RBC	Utility Worker RBC	Background
RU 1		Sb, B, Cd, Mo, Ag, Tl	Sb, Be, B, Cd, Mo, Se, Ag, Tl	Sb, Be, B, Cd, Mo, Se, Ag, Tl
RU 4		Sb, B, Cd, Mo, Se, Ag, Tl	Sb, B, Cd, Mo, Se, Ag, Tl	Sb, B, Cd, Mo, Se, Ag, Tl
RU 7	Sb, Pb, Hg, Mo, Ag, Tl	Sb, Pb, Hg, Mo, Se, Ag, Tl	Sb, Pb, Hg, Mo, Se, Ag, Tl	Sb, Pb, Hg, Mo, Se, Ag, Tl
RU 9		Sb, Mo, Ag, Tl		Sb, B, Hg, Mo, Se, Ag, Tl
RU 12		Sb, As, Hg, Mo, Se, Ag, Tl	Sb, As, B, Hg, Mo, Se, Ag, Tl	Sb, As, B, Li, Hg, Mo, Se, Ag, Tl
RU 13			Sb, Mo, Ag, Tl	Sb, Mo, Ag, Tl
RU 20	Sb, As, Cd, Co, Pb, Li, Hg, Mo	Sb, As, Cd, Pb, Li, Hg, Mo, Se, Tl	Sb, As, B, Cd, Pb, Hg. Mo, Se, Ag, Tl	Sb, As, B, Cd, Pb, Hg. Mo, Se, Ag, Tl

For samples where > 50% of the data are nondetects, nonparametric methods are appropriate.

<u>FMC Response:</u>

As discussed with the agencies during the August 3rd coordination meeting, the following approach has been adopted in the December 2004 RI Update Memo:

1. For sample sizes >4 but <10, the 95% UCL of the mean will be calculated using a non-parametric technique. This will negate any underlying distribution assumption, and no tests for distribution will be performed or presented. Where non-detects are included in the dataset, the procedures outlined in "Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites" Appendix A (EPA, 2002), will be applied.

2. No testing of sample size sufficiency will be conducted where the 95% UCL of the mean is less than 1/10 the lowest RBC value. This is because checks on sample size sufficiency are meant to determine if the desired power (i.e., ability to reject the null hypothesis when it is false) in a test has been achieved. When the test rejects the null hypothesis, then power is not an issue.

3. If the 95% UCL is within a factor of 10 of the lowest RBC value, the appropriate estimation of the variance will be made and the sample size sufficiency will be analyzed.

4. For depth intervals and RU's where there are <4 samples available, no statistical tests will be performed, and a data gap will be identified (the DQO process will be used to determine the number of samples needed, and this will be documented in the SRI Work Plan).

5. Regarding the issue of correlation, the geologic conditions at the FMC Plant OU and the spacing of the borings argue against correlation, either horizontal or vertical. Native soils at the FMC Plant OU are loess, a wind-blown silt. These soils were the first encountered in most of the borings that penetrated native soils. Given the geologic processes that affected the deposition and sorting of the loess, there is no reason to assume samples would be correlated (i.e., concentrations from one sample would be directly dependent on a nearby sample). Furthermore, the descriptions on the boring logs indicate the shallow soils are reasonably homogeneous. (Appendix B of the EMF RI Report).

Regarding the combining of datasets, the RI Update Memo will separately evaluate the slag data, ferrophos data, and the native soils data at various RU's, rather than combining data. The 95% UCL for the fill materials and the native soils will be compared to the RBCs as distinct populations. This approach should also address the issue of bimodal distribution and provide a more defensible decision when determining exposure point concentrations.

89. Section 6.1.4, Page 6-21, Methods

Given the limitation of the Shapiro-Wilk test for small sample sizes as discussed in the previous comment, the tables in Appendix C are inadequate. The calculated W value for each data analysis must be included and additional methods must be assessed for determination of distribution. As skewness is an important assumption in the distribution calculation, the tables in Appendix C should include the calculated skewness of the data population. It should be noted that taking ½ of the censored data alters the skewness of the true, unknown, population, again raises the question of the appropriateness of the test. The correlation coefficient from a Q-Q plot can give another indication of the normality of the data set.

FMC Response:

Please refer to the response to Specific Comment 88.

90. Section 6.1.4, Page 6-21, Methods, Comments on Sample Size & CLT

The sample size equation is not included in the document, but the use of the EPA DQO process implies that the following formula may have been used:

$$n = \frac{\left(z_{1-\alpha} + z_{1-\beta}\right)^2 s^2}{\Delta^2} + \frac{z_{1-\alpha}^2}{2}$$

If this is, in fact, the formula that was used, then the following comments apply. If another equation was used, then the formula must be included along with a discussion of the assumptions used in the derivation of the equation and how those assumptions relate to the calculated n value.

First, it is assumed that data are drawn from an approximately normal distribution. Second, it is assumed the data are uncorrelated. It is not clear that the data are uncorrelated. The document must be revised to discuss sample depth and sample location in order to assess the appropriateness of assuming the data are uncorrelated.

FMC Response:

Please refer to the response to Specific Comment 88. The appropriate equations and discussion are now incorporated into Section 6.1.4, Step 4.

91. Section 6.1.4, Page 6-21, Methods

For a number of RUs the number of samples used for a statistical analysis is not large enough. Gibbons (2003) indicates that a minimum of 20 samples is needed to provide the best confidence limit result having adequate power. The following tables indicate those situations where decisions were made with insufficient data based on the assumptions inherent for a statistical approach.

RU	**Site Worker RBC**	**Construction Worker RBC**	**Utility Worker RBC**	***Background***
RU 1		4	5	9
RU 4		6	10	14
RU 7	7	14	17	17
RU 9		4		17
RU 12		17 or 12	29 or 22	42 or 35
RU 13			4	4
RU 20	7	13	17	17

Decisions based on statistics without an adequate data set are not valid. Either the RI Update Memo needs to describe how an adequate number of samples will be collected, or an alternate approach must be proposed to evaluate the data.

FMC Response:

Please refer to the response to Specific Comment 88.

92. Section 6.1.4, Page 6-21, Methods

For each RU where data has been combined from various types of sampling, an evaluation needs to be done to show whether the data sets can be combined into one data set. The same analyses must assess whether soil samples from < 10 feet are from the same population as data from > 10 feet.

It is statistically inappropriate to combine data sets without first demonstrating that the data comes from the same populations. As an example, the 17 data for RU 20 are composed of ten soil samples, six slag composite samples, and one ferrophos composite sample. If the separate data sets have a normal distribution, then the F-test can be used to test whether the standard deviation are the same and the t-test can be used to test whether the means are the same. If the separate data sets are nonparametric, then other tests can be used to check whether the data sets can be combined (e.g. Levene's test, Kruskal-Wallis test).

FMC Response:

Please refer to the response to Specific Comment 88.

93. Section 6.1.4, Page 6-21, Methods

The document states that the ProUCL software was used to calculate the 95% UCL. Appendix C of the current document has chosen methods that do not conform to the ProUCL guidance documentation. These methods must be corrected or explained.

Specific deviations for constituents with log-normal distributions but where different methods were chosen methods as compared to ProUCL guidance Table A.2 include:

RU	Site Worker RBC	Construction Worker RBC	Utility Worker RBC	Background
RU 1			Ni	F
RU 4		As, Co, Hg, Mo, V, Zn	B, Hg, Ni, Se, V	Al, B, Li, P, K
RU 7	As	As, Pb, Li, Hg	Ba, Mn, Hg	Al, Ba, Mg, Mn, Hg
RU 9				Li
RU 12		Ba	Ba	
RU 13				Al, Ca
RU 20		Mn, Se		

FMC Response:

Please refer to the response to Specific Comment 88.

94. Section 6.1.4, Page 6-24, RU 4, 4th Paragraph

It is unclear why the laboratory seepage pit and the disposal area behind the laboratory are discussed in the section for RU 4, as Figure 6-25 suggests that these SWMUs are located in RU 5. Clarify this inconsistency.

FMC Response:

The discussion of the laboratory drainfield and the disposal area behind the laboratory is now included in RU 5, not RU 4.

95. Section 6.1.4, Page 6-24, RU 4, 4th Paragraph

The EMF RI data suggests that there has been migration of organic contaminants to depth from this disposal pit. It is unclear whether groundwater has been impacted at this site. Based on review of the limited existing data, the conclusions that there is no source of organic compounds to groundwater from this site or that no soil impacts have occurred is not supported. The RI Update Memo must be revised to indicate that that some contaminant migration has occurred but that the existing groundwater monitoring network does not indicate a contaminant plume emanating from these sites.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004. The text has been revised to state:

"The remediation vision for RU 4 is "no further action anticipated to be necessary". However, during the EMF RI, toluene was detected in boring F028B in low levels in all sampled soil horizons. The VOCs detected in F028B are thought to be associated with the Chem Lab Seepage Pit (SWMU 39). Although the EMF RI concluded that there were was no indication of a VOC source to groundwater, there is some uncertainty and additional characterization will be needed."

96. Section 6.1.4, Page 6-25, RU 4, Last Paragraph

Since no samples have previously been collected from the disposal area behind the laboratory, it is premature to conclude that this site could not be a potential source of groundwater contamination. Organic compounds were detected at depths of up to 70 feet beneath the laboratory seepage pit. The SRI must investigate the nature and extent of contamination (including contaminant migration) in this area and at RU 5.

FMC Response:

This comment was addressed in the proposed RI Update Memo revisions submitted to EPA on September 7, 2004. In these revisions, FMC noted that there is a potential for groundwater impact at this area that will be investigated during the SRI.

97. Section 6.1.4, Page 6-26, RU 9, 1st Paragraph, Last Sentence

A description of the "silica" that was used to backfill the kiln scrubber overflow pond (e.g., was this material a coarse siliceous sand or a fine-grained, manmade product) must be provided.

FMC Response:

The RI Update Memo has been revised to note: "Silica was formerly a process feedstock and is a naturally-occurring weathered quartzite that was mined at the Wells Cargo Mine, approximately 7 miles south of the FMC facility. Silica was crushed and screened at the mine then stockpiled on the plant site. Silica used in the elemental phosphorus process had a typical diameter ranging from 0.5 to 1.5 inches."

98. Section 6.1.4, Pages 6-26 & 6-27, RU 9

This section appears to include the kiln scrubber overflow pond, although the text is not clear regarding the ditch leading to it. It would seem more appropriate to include the kiln scrubber overflow pond and ditch with RU 8 based on process knowledge.

FMC Response:

Please see response to Specific Comment 71. The portion of the ditch within the boundaries of RU 9 are considered part of RU 9, the portion of the ditch that falls within the boundaries of RU 8 is considered part of RU 8. Please see Figures 6-8 and 6-31.

99. Section 6.1.4, Page 6-28, RU 12, 1st Paragraph

The document must state whether the EMF RI sampled for TPH in this RU. The sample depths and results for this data must be provided.

FMC Response:

The RI Update Memo has been revised to note that twelve samples were collected and analyzed for TPH in RU 12 during the EMF RI, recognizing that TPH is within the CERCLA petroleum exclusion. Sample depths ranged from 0.5 to 3 feet, and the reported TPH concentrations ranged from 30.1 mg/kg to 9025.2 mg/kg. Nine of the twelve samples had reported concentrations less than 200 mg/kg. Results are discussed in Section 4.2.3 of the RI Report (pages 4.2-122, 123, 131-135, and 138).

100. Section 6.1.4, Page 6-28, RU 12, 2nd Paragraph, 3rd Sentence

Additional information must be provided regarding the evidence suggesting the underground pipes leaked. Indicate what contaminants were detected, what contaminants were expected based on process knowledge of wastes carried through those pipes, whether the EMF RI looked for the entire suite of contaminants expected to be present in releases from the pipes, and the depths of contamination investigated and found.

FMC Response:

The RI Update Memo has been revised to note: "The EMF RI investigated the pipeline cleanouts located in RU 12. These pipelines transported phossy water to the ponds, where the solids were allowed to settle. Cleanouts were placed to access these pipes in the event they became clogged with phossy solids.

Inorganics and radionuclides were analyzed from soil samples collected around the pipeline cleanouts. The typical suite of phossy water constituents were detected in the shallow soil samples (cadmium, fluoride, zinc in addition to orthophosphate, arsenic, and several trace metals). Borings were drilled to depths ranging from 7 to 25 feet from grade. A detailed review of the results of this investigation is presented in the EMF RI Report, Section 4.2, pages 97-106."

101. Section 6.1.4, Page 6-29, RU 12, Last Paragraph

The document must discuss process knowledge regarding PCB use in this RU. It is unclear why PCB hotspots are a concern. Figure 6-36 identifies the location of a PCB storage shed. Clarify whether this is the only potential PCB source in this area, or if there is any indication that PCBs may have been stored or disposed elsewhere in this RU.

FMC Response:

The potential for PCB hotspots is a concern because PCB transformer oils were stored in the PCB Storage Shed. The EMF RI analyzed shallow soil samples for PCB's in this area. However, FMC believes that additional sampling is needed to support a decision at the appropriate confidence levels regarding the presence/absence of PCBs in isolated areas (i.e., "hotspots"). The PCB Storage Shed is the only area where PCBs were stored in this area. The PCB Storage Shed was a concrete block structure with a concrete floor; there was no visible staining of the floor or walls prior to its demolition. The PCB Storage Shed no longer exists; it was removed during construction of the LDR Treatment System in 2000 and the area was regraded.

102. Section 6.1.4, Page 6-30, RU 15 & Figure 6-40

Based on review of Figure 6-40, it appears that only one boring, F127B, was completed within the RU boundaries. Boring F108B was completed to a depth of only 2.5 feet in the roadway to the west of this RU, and would not be expected to be representative of site conditions in RU-15. Based on the figure, this boring was located east of the RU boundaries also in a roadway. Provide a reference to an EMF RI table containing information regarding boring F163B.

FMC Response:

The December 2004 RI Update Memo has been revised to note: "Boring 163B was initially drilled to install a groundwater monitoring well. However, water-yielding material was not encountered. A single sample from a depth of 21 feet was analyzed for selenium. Results for this analysis were ND (1.4 mg/kg UJ). This information was not discussed in the RI Report, but was submitted to EPA during the RI."

Shallow samples from Boring F108B are representative of shallow materials at RU 15.

103. Section 6.1.4, Page 6-30, RU 15 & Figure 6-40

Based on the RU description presented in Figure 6-39, wastes at this site are heterogeneous consisting of mounds of reject ore, baghouse dusts from multiple sources, and pieces of carbon electrodes. No information is presented to indicate the type of wastes present in the immediate vicinity of boring F127B. A characterization of these wastes must be provided.

FMC Response:

The December 2004 RI Update Memo has been revised to note: "A characterization of the wastes around boring F127B was presented in the EMF RI Report, page 4.2-166. The boring encountered calciner pond sediments at a depth of 5 feet, and native soils below that interval. See also Table 4.2.3-33 of the EMF RI Report for the data from boring F127B."

104. Section 6.1.4, Page 6-30, RU 15 & Figure 6-40

A discussion regarding the depth of contaminant migration observed in Boring F127B, and whether it would be reasonable to expect this depth of migration throughout this RU, given the heterogeneous waste materials present must be provided. This information will be required for cap design.

FMC Response:

The RI Update Memo has been revised to reflect historical uses at RU 15, and to acknowledge the uncertainties associated with the data and potential for contaminant migration.

105. Section 6.1.4, Page 6-30, RU 15

This RU discussion is confusing. The remediation vision presented in the fourth paragraph suggests that the RU poses an unacceptable risk. However, this does not appear to be supported by the data that are briefly mentioned in the sixth paragraph. Although there are insufficient samples to compare statistically to RBCs or background concentrations, the last paragraph concludes that there are no data gaps. It is unclear whether an unacceptable risk has been identified at this RU, or whether an unacceptable risk is simply presumed based on process knowledge of waste materials present. The text must be modified to clarify these issues.

FMC Response:

Based on data collected during the EMF RI, ore exceeds the Site Worker RBC for arsenic, and ore is the primary material stored within RU 15. Therefore, it was concluded that RU 15 poses an unacceptable risk to future site workers via direct exposure. The text has been revised to reflect this.

106. Section 6.1.4, Pages 6-31 & 6-32, RU 23, 1st Paragraph

The document must be revised to clarify which road segments are included in this RU. The text states that Figure 3-1 identifies the road segments in this RU, but roadway borings are shown both inside and outside of the RUs on this Figure. Additionally, the legend in the upper right corner of Figure 3-1 states that RU 23 road segments are "not shown." This is especially confusing because individual RU Figures (e.g., Figure 6-40) also depict roadway borings that appear to be outside of the RU boundaries. For example, it is unclear whether borings F108B and F163B are intended to be included as data for RU 15 or RU 23.

FMC Response:

All road segments that are not within the other RU boundaries, but within the FMC Plant OU area, are considered part of RU 23. All plant roadways are shown in Figure 3-1, and the note has been revised, as noted above.

Borings F108B and F163B are included in the dataset for RU 15, not RU 23.

107. Section 6.1.4, Pages 6-31 & 6-32, RU 23, 1st Paragraph

The rationale for separating the road segments into various RUs should be explained. It may be more appropriate to include all shallow roadway borings under RU 23, since the same road construction materials were probably used throughout the facility.

FMC Response:

The RU boundaries were primarily developed based on similarity of use and contaminants within the RU, but FMC also considered establishing the RUs as logical parcels for redevelopment. The decision to include road segments within the RU itself is logical, because redevelopment projects would not likely use the existing roads, particularly if the road falls in or near the middle of new parcels/lots. Road materials sampled within the RU boundaries are part of the dataset that characterize future worker (site workers, construction workers, and utility workers) exposure to COCs and COPCs.

The rationale was presented in the Scoping and Planning Memorandum (FMC, 2003).

108. Section 6.1.4, Pages 6-31 & 6-32, RU 23 - Statistical Summary and Data Gaps

The text states that statistical analyses were not performed for inorganic constituents within RU 23 because there were insufficient data, but instead refers to the analysis conducted under RU 20. However, review of EMF RI table 4.2.3-20 and EMF RI text (pages 4.2-125 though 4.2-138) indicates that numerous borings were completed in and just beneath the roadways, and included inorganic analyses, radionuclides, and occasionally TPH and PCBs. It is not clear why these data are not used. The document must include this information.

FMC Response:

The RI Update Memo has been revised to note: "Most of the road samples were collected on road segments that are within the boundaries of other RU's. The practice adopted for the RI Update Memo was to evaluate the data only within the boundaries of an RU (with the exception of slag composite samples). Therefore, all of the road characterization data are used in the RI Update but there were insufficient data to evaluate road segments that are outside the boundaries of RUs 1 through 22."

109. Section 6.1.4, Pages 6-31 & 6-32, RU 23 - Statistical Summary and Data Gaps

Under the "Data Gaps" subsection, the only data gap identified is gamma radiation. However, review of the above-referenced EMF RI data indicates that inorganic constituents were commonly found in excess of comparison criteria in these shallow roadway borings. All COPCs must be compared to RBCs and those exceeding the RBCs must be sampled for unless a presumptive containment remedy is being proposed.

FMC Response:

The RI Update Memo has been revised to note:

"Because the roads are made of a slag road base, FMC believes the inorganics on roadways require no further characterization. However, gamma radiation from slag has not been adequately characterized for individual road segments."

In addition, the RI Update Memo has been revised to show that precipitator dust was applied to FMC roads in the past to provide traction in winter months. Lead-210, the primary COC in precipitator dust will be characterized on roads to support the SFS.

110. Section 6.1.4, Pages 6-31 & 6-32, RU 23 - Statistical Summary and Data Gaps

Since previous roadway sampling did not include analyses of surficial materials, all COCs present in the roadway materials have not been taken into account, and the results are not representative of site risks. As indicated above, inorganic constituents were commonly detected above EMF RI comparison criteria, and radionuclide samples were not collected and analyzed. The text must be modified to identify radionuclides and other COPCs as data gaps that require additional sampling.

FMC Response:

During the EMF RI, 48 samples of surficial materials were collected and analyzed for inorganics (48 samples), organic compounds and/or TPH (17 samples), PCBs (17 samples), and radiological parameters (32 samples). These samples are representative of the surficial roadbed material because of frequent road maintenance and constant heavy equipment traffic on plant roadways would have mixed material deposited on the surfaces into the upper 6 to 12 inches of road base. FMC had a road grader dedicated to maintaining unpaved roads.

As described in the response to General Comments #3 and #4, FMC will characterize radionuclides in roadbed materials. Specifically, Pb-210 and Po-210 associated with the past use of precipitator dust in winter months.

Please see the revised discussion of data gaps for RU 23 in Section 6.1.4.

111. Section 7, Page 7-1, Summary and Next Steps

This summary must take into account radionuclides known to be present at the site. Currently, descriptions of risks associated with radionuclides are limited to gamma measurements. Risks from individual radioactive constituents in facility wastes (including slag, precipitator dust, calciner wastes, ferrophos, and other fill and wastes at the facility) need to be characterized.

Radionuclide analyses needs to be discussed as a data gap and additional sampling needs to be conducted.

FMC Response:

The summary includes a review of radionuclides known to be present at the site. FMC disagrees with the position that risks associated with radionuclides in facility feedstocks, by-products, and waste materials require further characterization. Please refer to FMC's response to General Comments 3 and 4 with respect to this issue and the balance of this comment.

112. Appendix A, All Tables, General Comment Regarding Roadways within RUs

The following text appears under the "Post-RI releases that might have impacted environmental media" column. "Water withdrawn from the RCRA ponds during closure and treated in the waste water treatment unit (PCDT) system to meet the Universal Treatment Standards (UTS) applied to the roads in 2004 and 2005 for dust control. No documented post-RI releases to roads." The two sentences are somewhat confusing and appear to be inconsistent with one another. This issue must be discussed in more detail in this document. For example, it is unclear whether the pond liquids contain radionuclides that would increase cumulative risks in the application areas. Likewise, it is unclear whether repeated applications of fluids with hazardous constituents at UTS concentrations could appreciably add to the CERCLA cumulative risks determined for the roads. Information must be provided regarding the application rates, volumes, and frequency of application. A demonstration that the application process is protective and not inconsistent with the CERCLA SRI, and will not enhance contaminant migration should be included. The document should reference or include this evaluation.

FMC Response:

The December 2004 RI Update Memo has been revised to note: "An evaluation of the application process was performed and the results submitted to EPA in a transmittal dated November 21, 2003. There was no indication that use of treated pond water for dust suppression would adversely impact the road materials. The mass of applied constituents was calculated, and the estimated increase in concentrations/activities was well below the 1998 RBCs."

Water application rates are intended to only wet the road surface, which will not provide a mechanism for deeper migration of dissolved constituents. For example, the water applied to roads over an eight-month period from March through October will be approximately 13 inches. Evaporation potential in this area of Idaho exceeds 40 inches per year while the Mean Annual Precipitation is 11 inches per year.

Water is not applied to roads after rain events. It is only applied when dust abatement is required. This practice further reduces the potential for mobilizing constituents in the roadbeds.

113. Appendix A, Section A.2, Page A-2, Figure A-3: FMC Facility Summary (Actual figure located in Section 4.2.3.1 EMF RI Report), Fourth Bullet

A review of the Roads subsection of the EMF RI (RI pages 4.2-125 through –138, and Tables 4.2.3-20 and 4.2.3-6) indicates that contamination was commonly detected as deep as sampled.

In such instances where the deepest sample collected was from a depth of approximately two feet, and analyte concentrations in that sample exceed comparison criteria, it should not be concluded that the soil beneath that depth was not impacted. In some cases, samples were collected below 2 feet, and some of the analytes detected at those deeper depths exceed comparison criteria in the RI. The existing data should be compared to the new RBCs to ensure that the existing sample concentrations do not exceed RBCs. If additional data is necessary the RI Update Memo must be revised to indicate this is a data gap.

FMC Response:

The comment refers to a quotation of a summary bullet reprinted from the EMF RI Report. The EMF RI Report was approved by EPA in 1996. It is not within the scope of the RI Update Memo to revise the EMF RI Report.

114. Appendix A, Section A.3.1, Page A-4, 5th and 6th Bullets

Although the IWW discharges and stacks/vents/other plant air emissions have ceased with plant shutdown, it is not clear how contamination resulting from historic releases from these SWMUs is being addressed. The document must be revised to address these sources.

The RI Update Memo must include a discussion of the IWW sediment that is buried at the site, the buried former CO flare pit, and other areas now buried at the facility.

FMC Response:

The EMF RI, HHRA, and Ecological Risk Assessment (BERA) evaluated historic releases from these SWMUs that may have impacted areas outside the FMC Plant OU. Section 6 of the RI Update Memo identifies data gaps associated with characterization of IWW sediments remaining within the FMC Plant OU. The slag berm surrounding the former CO Flare Pit and slag within the perimeter of the Flare Pit were removed during construction of the Excess CO Combustor. FMC believes that no residual contamination remains within the footprint of the former CO Flare Pit. FMC is not aware of any units now buried at the facility that were not already identified in the June 2004 draft of the RI Update Memo.

115. Appendix A, Section A.2, Page A-2, Figure A-3: FMC Facility Summary (Actual figure located in sec. 4.2.3.1 EMF RI Report), Sixth Bullet

A review of the Roads subsection of the EMF RI (RI pages 4.2-125 through –138) indicates that TPH contamination was sometimes detected as deep as sampled. In these instances, it should not be concluded that TPH is not detected at depth in these locations. This must be discussed in the RU summary and additional data collection proposed.

FMC Response:

Please see response to Specific Comment 113.

116. Appendix A, Section A.2, Page A-2, Figure A-3: FMC Facility Summary (Actual figure located in sec. 4.2.3.1 EMF RI Report), Last Paragraph, Last Sentence

The limited data for organic contaminants collected during the original RI indicates contaminant migration from the waste zones under conditions without sustained hydraulic head. Additionally, some inorganic contaminants appear to have migrated out of the waste zone at some sites that do not have sustained hydraulic heads (e.g., RU 16). Discussion in other sections of this document needs to make it clear that the conclusions in the 1991 RI Report may not be supported by the existing data.

FMC Response:

Please see response to Specific Comment 113.

117. Appendix A, Section A.3, Page A-2, Table A-16, SWMU-17, Storage Area B

It appears that some of the borings described under the "EMF RI Findings" column were actually drilled in RU's 14 or 15 (i.e., F128B, F050B, and F127B). Please delete references to these two borings from the RU17 line item, and move to the appropriate RU descriptions.

FMC Response:

The appropriate revisions have been made in the December 2004 RI Update Memo.

118. Appendix A, Section A.3, Page A-2, Table A-16, SWMU-17, Storage Area B

The information presented in the "Current Status" column indicates that a soil cap was installed over this portion of RU 16 in 1993. This information must be discussed in the RU 16, Section 6 of RI Update, since it will be important for remedial design. Section 6 must be revised to describe the extent of the 1993 remediation effort, including cover materials, lateral extent, cover thickness.

FMC Response:

Agreed. Information regarding the partial cover is presented in Section 6 (see new Figure 6-10a).

119. Appendix A, Section A.3.1, Page A-4, 4th Bullet

The limited data for organic contaminants collected during the original RI suggests that at some sites there appears to be, or the potential exists for, contaminant migration from the waste zones under conditions without sustained hydraulic head. Currently, there may not be monitoring wells located appropriately to intercept potential releases from these sites. Please delete this bullet and modify the conceptual site model to depict this potential release mechanism.

FMC Response:

Please see the proposed document revisions submitted to EPA on September 7, 2004. SWMUs where materials containing free liquids may have been managed are identified in Appendix A.

120. Appendix C, Title page, Appendix C

The Statistical Analysis Site Data Comparisons With: 1998 RBC's, Updated Site Worker RBC's, Construction Worker RBC's Utility Worker RBC's, and Background, must be updated to include RBCs for radionuclides as discussed in other comments.

FMC Response:

Please refer to FMC's response to Specific Comment 31 and related comments regarding radionuclide characterization.

121. Appendix C, Section RU 1, Page C-2, Table C-3

A brief review of Table C-3 reveals the fifth number listed under the column labeled Antimony is 8.15. This value implies there should be a 16.3 ppm in Table C-1 under the Antimony column, but there is not. More thorough QA/QC procedures need to be used to address possible transcription errors that could affect data analysis.

FMC Response:

Agreed. A detailed check will be made of all data used in the statistical analyses.

122. Appendix C, Section RU 20, Page C-4, Table C-26, All Data Columns

It is not clear how the 13th data point was chosen for this RU. In all previous tables, the Construction Worker RBC was based on the combined data from 0-2 feet and 2-6 feet. For RU 20, those two data sets would be composed of a total of 12 data points. It is not clear why sample #F084B, obtained from a 7-foot depth, was added to each of these data sets.

FMC Response:

Agreed. An error occurred in the data manipulation, and this has been rectified in the December 2004 RI Update Memo.

123. Appendix D, General Comment

Note that although geotechnical data from a proposed borrow area are presented in this Appendix, these data cannot be evaluated for suitability as cover material until cap design is provided for review.

FMC Response:

Comment noted.

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APPENDIX H
SWAP PAGES

Appendix H

XRF Screening for Phossy Solids

As documented in Appendix F of this report, analysis of available radionuclide-specific data for the various feedstocks and waste streams historically processed at the FMC Plant OU demonstrates that external exposure to gamma radiation drives risks to potential future workers for all source materials (except phossy solids) at the FMC Plant OU. With respect to phossy solids (including precipitator dust), incidental ingestion and fugitive dust inhalation of lead-210 and polonium-210, together with external exposure to gamma radiation, contribute virtually all of the risk to workers exposed to this source material. Therefore, analyzing samples for lead-210 and polonium-210, in conjunction with taking gamma dose rate measurements, is proposed to address radiological risks in areas that may contain phossy solids. The purpose of this appendix is to provide an outline of the approach that will be used identify the presence of phossy solids at gamma dose rate measurement sites during the SRI. The approach is outlined conceptually in this document, and is provided for information only. Complete documentation of this methodology will be submitted to the EPA for approval in the SRI Work Plan.

Phossy solids (including precipitator dust) are characterized by relatively high concentrations of arsenic, cadmium, lead, silver, and zinc when compared to the concentrations of these same metals in ore, ferrophos, and slag. These metals can be detected via field portable x-ray fluorescence (XRF) spectroscopy. Table H-1 presents the concentrations of metals in phosphate ore and ferrophos. Table H-2 presents the concentrations of metals in pond sediment (i.e., precipitator slurry) and Table H-3 presents the concentration of metals in slag. The ratios of the concentrations in precipitator dust and the concentrations in ore, slag and background are presented in Table H-4. These ratios were calculated by dividing the average concentrations in precipitator dust by the average concentrations in ore and slag. For the ratios between precipitator dust and background concentrations, the EMF RI background levels were used. As shown in Table H-4, the higher values indicate the relative enrichment of the metal in the precipitator dust when compared other materials that might be mixed with precipitator dust.

Column 5 of Table H-4 highlights, in bold text, metals with concentrations in pond sediments that are greater than approximately twenty times the concentrations found in slag. While the ratios of arsenic and silver concentrations are high, the actual concentrations are near the XRF detection levels for these metals. Arsenic and silver are therefore not considered good candidates as indicators for phossy solids. Table H4 does however indicate that cadmium, zinc and possibly lead may be used to indicate the presence of phossy solids.

H1 Conceptual Sampling Approach

Details of the sampling approach will be provided in the supplemental remedial investigation work plan. The conceptual framework for the proposed work includes collecting samples from a sub-set of the locations at which gamma dose rate measurements are taken during the SRI, and screening these samples for the presence of phossy solids in an on-site laboratory using a field portable x-ray fluorescence spectrometer. In addition, any location containing fill material that exhibits the visual characteristics of phossy solids will be sampled and screened. Consistent with the approach being taken to collect gamma dose rate measurements, XRF screening during the SRI will be restricted to RUs for which a remedial vision of capping is not currently envisioned (i.e., RUs # 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 20, 21, and 23). Although there is no evidence of past releases of phossy solids in RUs 3, 4, 5, 7, 9, 11, 20, and 21, confirmation sampling for lead-210 and polonium-210 is needed to fully characterize the 0-10' depth interval.

To optimize detection levels the samples will be ground and screened to assure a consistent matrix. It is anticipated that samples will be obtained from the surface to approximately 2 feet bgs to evaluate the outdoor industrial/commercial worker exposure scenario. In addition, samples will be obtained from the base of test pits/trenches to evaluate the construction and utility worker exposure scenarios. Samples with concentrations of cadmium, zinc, and possibly lead indicating the potential presence of precipitator slurry will be shipped to a fixed laboratory for conventional metals and lead-210 analyses. The fixed laboratory will also analyze a fraction of the samples that are not suspected of having been impacted by phossy solids.

H2 Conceptual Analytical Approach

U.S. EPA, SW-846, Method 6200 will be used to perform the field measurements of cadmium and zinc. Using Method 6200, inorganic analytes of interest are identified and quantified with a field portable energy-dispersive x-ray fluorescence spectrometer. Radiation from one or more radioisotope sources or an electrically excited x-ray tube is used to generate characteristic emissions from elements in a sample. Method 6200 uses a sealed radioisotope source to irradiate samples with x-rays. When an atom absorbs the source x-rays, the incident radiation dislodges electrons from the innermost shells of the atom, creating vacancies. The electron vacancies are filled by electrons cascading in from outer electron shells. The outer shell electrons give off energy in the form of an x-ray as they cascade down into the inner shell vacancies. This rearrangement of electrons is termed x-ray fluorescence and the emitted x-ray intensities and energies are characteristic of specific atoms making identification and quantification possible.

Each characteristic x-ray line is defined with the letter K, L, or M, which signifies which shell had the original vacancy and by a subscript alpha (α) or beta (β), which indicates the higher shell from which electrons fell to fill the vacancy and produce the x-ray. For example, a $K\alpha$ line is produced by a vacancy in the K shell filled by an L shell electron, whereas a $K\beta$ line is produced by a vacancy in the K shell filled by an M shell electron. The $K\alpha$ transition is on average 6 to 7 times more probable than the $K\beta$ transition; therefore, the $K\alpha$ line is approximately 7 times more intense than the $K\beta$ line for a given element, making the $K\alpha$ line the choice for quantitation purposes.

The SRI Work Plan will describe the necessary cadmium and zinc detection levels, detail how the XRF analyzer will be used, and identify how soil samples will be selected for analysis using fixed-base laboratory methods. The fixed laboratory will use standard EPA methods for determining the total concentrations of metals in samples. It is anticipated that Method 6010B will be used for metals and Method 901.1 will be used for lead-210.

H3 Verification of the Conceptual Approach

Prior to implementing the proposed approach during the supplemental remedial investigation, a verification study will be performed to demonstrate that cadmium, zinc and possibly lead can be reliably used as indicator parameters for the potential presence of phossy solids/precipitator slurry. This verification study will involve analysis of approximately twenty-five composite samples of slag and precipitator slurry combined in several weight percentages from 100-percent slag to approximately 75-percent slag and 25-percent precipitator slurry. Each sample will be analyzed by field portable XRF and by a fixed laboratory for, at a minimum, lead-210, total lead, total cadmium and total zinc. The results of this verification study will be used to establish site-specific correlations between the field XRF measurements and fixed laboratory measurements and to identify any potential interferences that may limit the utility of the field XRF instrument as a screening tool.